DIGITAL VOICE SYSTEMS, INC.
The Speech Compression Specialists

AMBE-3000™-HDK
Development Board
Version 1.1
July, 2014

User's Manual

AMBE-3000™-HDK Development Board
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Version 1.1
July, 2014

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Digital Voice Systems, Inc
234 Littleton Road
Westford, MA 01886

(The most up to date version of the manual is always available at www.dvsinc.com)

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AMBE-3000™-HDK Development Board END USER License Agreement

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4. Term and Termination

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4.2 This Agreement shall terminate automatically without notice from DVSI if END USER fails to comply with any of the material terms and conditions herein. END USER may terminate this Agreement at any time upon written notice to DVSI certifying that END USER has complied with the provisions of Section 3.

4.3 Upon termination of this Agreement for any reason, END USER shall: (i) return the PRODUCT and documentation purchased or acquired, or in Licensee's possession, to DVSI; (ii) have no further rights to any DVSI Software or the Technology without a separate written license from DVSI; (iii) discontinue all use of the PRODUCT;

All confidentiality obligations of Customer and all limitations of liability and disclaimers and restrictions of warranty shall survive termination of this Agreement. In addition, the provisions of the sections titled "U.S. Government End User Purchasers" and "General Terms Applicable to the Limited Warranty Statement and End User License" shall survive termination of this Agreement.

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9. Limitation of Liability

The END USER agrees that the limitations of liability and disclaimers set forth herein will apply regardless of whether the END USER has accepted the product or service delivered by DVSI.

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9.2 Because some states or jurisdictions do not allow the exclusion or limitation of liability for consequential or incidental damages, the above limitations may not apply to END USER.

9.3 DVSI's maximum liability for damages arising under this Agreement shall be limited to 20% (twenty percent) of the fees paid by END USER for the particular PRODUCT that gave rise to the claim or that is the subject matter of, or is directly related to, the cause of action.

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11.1 United States export laws and regulations prohibit the exportation of certain products or technical data received from DVSI under this Agreement to certain countries except under a special validated license. Some of the restricted countries include: Libya, Cuba, North Korea, Iraq, Serbia, Taliban in Afghanistan, Sudan, Burma, and Iran. The END USER hereby gives its assurance to DVSI that it will not knowingly, unless prior authorization is obtained from the appropriate U.S. export authority, export or re-export, directly or indirectly to any of the restricted countries any products or technical data received from DVSI under this Agreement in violation of said United States Export Laws and Regulations. DVSI neither represents that a license is not required nor that, if required, it will be issued by the U.S. Department of Commerce. Licensee shall assume complete and sole responsibility for obtaining any licenses required for export purposes.

12. Governing Law

12.1 This Agreement is made under and shall be governed by and construed in accordance with the laws of the Commonwealth of Massachusetts, (USA), except that body of law governing conflicts of law. If any provision of this Agreement shall be held unenforceable by a court of competent jurisdiction, that provision shall be enforced to the maximum extent permissible, and the remaining provisions of this Agreement shall remain in full force and effect. This Agreement has been written in the English language, and the parties agree that the English version will govern.

Special Handling Instructions

To avoid damage from the accumulation of a static charge, industry standard electrostatic discharge precautions and procedures must be employed during handling and installation the AMBE-3000™-HDK Development Board.

Read Instructions and Users Manual – All of the safe handling and operating instructions should be read before integration of the AMBE-3000™-HDK Development Board begins. Failure to exercise reasonable care and to follow all instructions and heed all warnings may result in injury to property or to individuals.

Retain Instructions - The handling and operating instructions should be retained for future reference.

Follow Instructions - All operating and use instructions should be followed.

Storage

To insure maximum shelf life in long term storage, AMBE-3000™-HDK Development board should be kept in an a static shield, moisture controlled package at <40°C and <90% Relative Humidity

Installation

Ventilation - The AMBE-3000™-HDK Development Board unit should be situated so that its location or position does not interfere with proper ventilation and air circulation around the board.

Heat - The AMBE-3000™-HDK Development Board unit should be situated away from devices that could act as a heat source such as an amplifier.

Power Sources - The AMBE-3000™-HDK Development Board should be connected to a power source only of the type described in this Users Manual.

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Introduction

Overview

The Digital Voice Systems, Inc. (DVSI) AMBE-3000™-HDK Development Board is a comprehensive, evaluation, test and development platform that helps product designers and manufacturing engineers gain experience with the low-bit-rate AMBE-3000™ Vocoder Chip. The AMBE-3000™ HDK is ideal for comparing voice quality at various rates, analyzing the compressed voice data I/O stream and establishing interface requirements. This valuable knowledge gives engineers the insight required to start prototyping their own low-bit-rate communication systems quickly and easily thereby decreasing development costs and speeding up a new product's time to market.

The AMBE-3000™ HDK employs DVSI's AMBE-3000™ vocoder chip that is ideal in communication systems, including push-to-talk land mobile radio, satellite and wireless telephony. The AMBE-3000™ Vocoder Chip contains proprietary software that implements the Advanced Multi-Band Excitation AMBE® voice compression algorithm. The AMBE-3000™ Vocoder Chip is capable of data rates containing compressed speech and FEC data from 2.0 Kbps to 9.6 Kbps (in 50 bps increments),. This data rate flexibility makes the AMBE-3000™ HDK a cost efficient design and development tool for high performance, low bandwidth voice communication applications.

AMBE-3000™ HDK Features

- The AMBE®+2 Vocoder with high quality speech compression and FEC data rates that can be set from 2000 bps to 9600 bps.
- The development kit includes: circuit design details, sample control software and reference documentation.
- The HDK is equipped with a AIC14 codec to provide an analog audio I/O interface
- Vocoder and hardware configuration via dipswitches, jumpers and USB to PC interface.
- Encode and decode files to/from a PC through the USB interface.
- Real-time full-duplex communication between two HDK boards using the RS-232 and the analog 2-wire or 4-wire audio interface.
- Full Control of AMBE-3000™ Vocoder Chip advanced capabilities such as Soft decision FEC, Voice Activity Detection (VAD), adaptive Comfort Noise Insertion (CNI) and DTMF tones.
- Low power requirements allow the board to be powered with only a 5 Volt DC power adapter.

AMBE-3000™ HDK Description

The AMBE- 3000™ HDK is a completely functional system from the analog audio interface to the digital channel interface. The straightforward design of the board provides a variety of user interfaces and test points that allow designers to rapidly prototype their own AMBE-3000™ designs.

Digital Voice Systems' AMBE-3000™ Vocoder Chip is the core of the AMBE-3000™ HDK. All of the supporting chips on the board were chosen for their low cost, ease of use and wide availability. The control, I/O and timing of the board are handled by the Texas Instruments MSP430 microprocessor unit (MCU). The MSP-430 flash image is easily programmed using an MSP430-FET serial programmer a low cost development tool from Texas Instruments.

The AMBE-3000™ HDK is also a stand-alone voice processing board, equipped with connections for analog audio I/O, a RS-232 serial UART port communication channel interface, and a RS-232 packet interface port.

The AMBE-3000™ HDK can demonstrate the capabilities and benefits of the AMBE-3000™ vocoder chip in real time, without investing much time in engineering and product development. Once a new

product design is complete and manufacturing begins the AMBE-3000™ HDK can then be used to simulate actual system conditions as a quality control reference standard. Additionally, the HDK can be used to batch process files for evaluation of the vocoder.

What's Included with the HDK

The development kit includes the following items:
HDK evaluation board
Power Adapter (120v AC to 5 V DC)
Handset with cord
AMBE-3000™ HDK CD (The most up to date version of the manual is always available at www.dvsinc.com/brochures/literature.htm)

The AMBE-3000™ HDK CD contains the AMBE-3000™ User's Manual, program source code for the on board microprocessor (MSP430) (see Note) and a PC executable (with source) for interfacing the HDK with a PC, as well as a full set of schematics, reference designs and test vectors.

Note: The development tools for the MSP430 MCU are widely available and easily obtained from Texas Instruments and various sources on the web. This gives designers an opportunity to recompile the code to test other configurations. The main tool tree is Code Composer Essentials. This allows for a robust development environment free of cost (up to 16Kb).

Connectors, Test Points & Indicators

Overview of HDK Interfaces

The AMBE-3000™ HDK is designed with flexibility in mind. It provides a variety of interfaces that allow for fast and easy integration and testing.

The AMBE-3000™-HDK can be used as a standalone development tool or, be connected to another AMBE-3000™-HDK via the RS-232 channel interface to demonstrate its capabilities as a full-duplex real-time communication system.

With a PC the board can encode speech data from the handset, 3.5mm stereo jack (Line In) input connections, or it can process speech files from a PC (USB connection). When connecting two boards together the RS-232 interface acts as the channel for the compressed voice serial data bit stream. The RS-232 Channel I / O is an asynchronous serial interface that uses a protocol designed by DVSI.

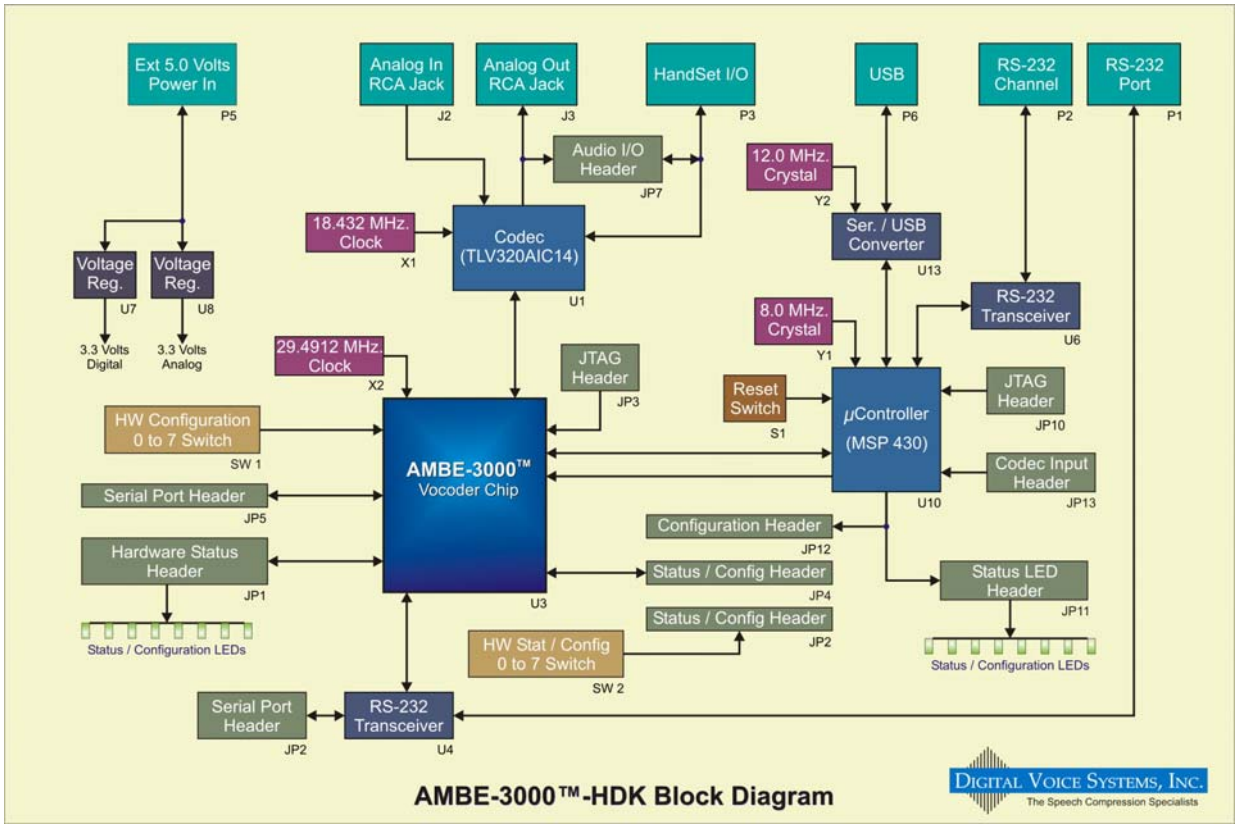


Figure 1 Basic block diagram of the AMBE-3000™ HDK board

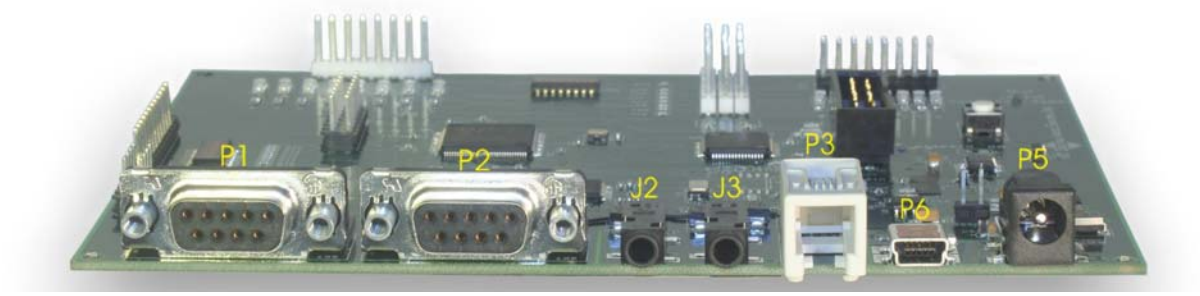


Figure 2 Board Connections

Board Connections0			
Item	Name	Connector Type	Description
P5	DC Line In	Power Receptacle	5 Volts DC
P6	USB	Mini USB B SMT	PC Connection
P3	Handset	RJ-11	Full Duplex Communication
J3	Audio Output	3.5 mm Plug	Speakers
J2	Audio Input	3.5 mm Plug	Microphone
P2	Serial Port	DB-9s	Packet Data (to/from MSP)
P1	Serial Port	DB-9s	Packet Data (to/from AMBE-3000™ Vocoder Chip)

Table 1 HDK Connectors

DC Power (P5)

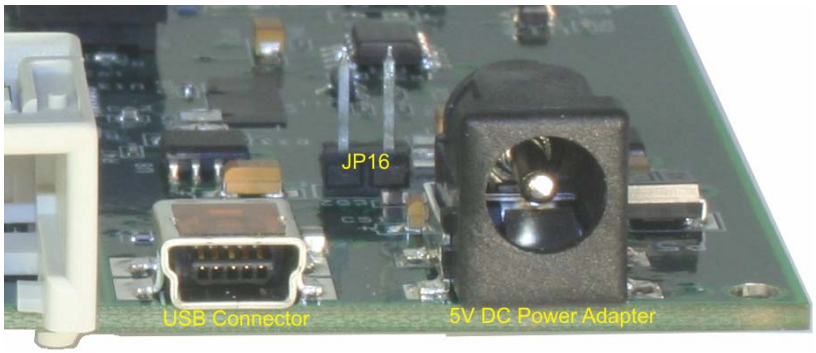


Figure 3 Power Input Connection

The AMBE-3000™-HDK Development Board operates with a 5.0 V DC power supply. Simply plug in the 120 V AC to 5.0 V DC (~250ma) power source (provided with the HKD) into an AC power source and the DC power receptacle (P5)

USB Connection

The USB 2 connection on the AMBE-3000™ HDK provides system setup, mode of operation and file I/O via PC.

Figure 4 USB Connector

Control and operation of the HDK Board is done through the USB interface. To connect the AMBE-3000™ HDK to a PC's USB port, a USB "Type A to Mini-B" cable is required (included with the HDK). To use the USB interface it is first necessary to install a USB driver.

The AMBE-3000™ HDK Board requires the TUSB3410/5052 device driver available from Texas Instruments. TI's USB driver is easy to install and is available to download from TI's website http://www.ti.com/lit/zip/sllc428 It is a Microsoft WHQL Certified VCP driver for Windows.

NOTE: Be sure to install the USB driver before connecting the AMBE-3000™ HDK to a PC's USB port.

USB driver installation steps:

- Step 1 Go to the link above and download the USB Driver **(sllc428a.zip (3.6MB))** this file contains TI_WDF_USBUART_SINGLE_DRIVER_V6.7.2.0_WHQL.exe. Note in order to download the file you must be a "my.ti" registered user. Visit https://myportal.ti.com/portal/dt?lt=myti&provider=TIPassLoginSingleContainer&goto=http%3A//focus.ti.com/general/docs/interimdownload.jsp%3Fdest_url%3Dhttp%253A//focus.ti.com/general/docs/lit/getliterature.tsp%253FbaseLiteratureNumber%253Dswrc094%2526fileType%253Dzip for registration and login information.
- Step 2 Create a folder on your C:\ named HDK
- Step 3 Unzip the sllc428a.zip file to this folder and run the setup.exe program to install the driver.
- Step 4 Once the driver is installed the HDK Board can be connected to the PC via USB.
- Step 5 Verify the driver is installed and working by checking what COM port it has been assigned.

To find this information use Windows "Device Manager". To open Windows "Device Manager"

- Click Start, click Run, and then type "devmgmt.msc" (without the quotation marks).

NOTE: When using the USB Interface, connecting more than one HDK board to the same PC at the same time could result in a MSWindows fault. Therefore it is recommended to connect only one HDK to a PC at a time.

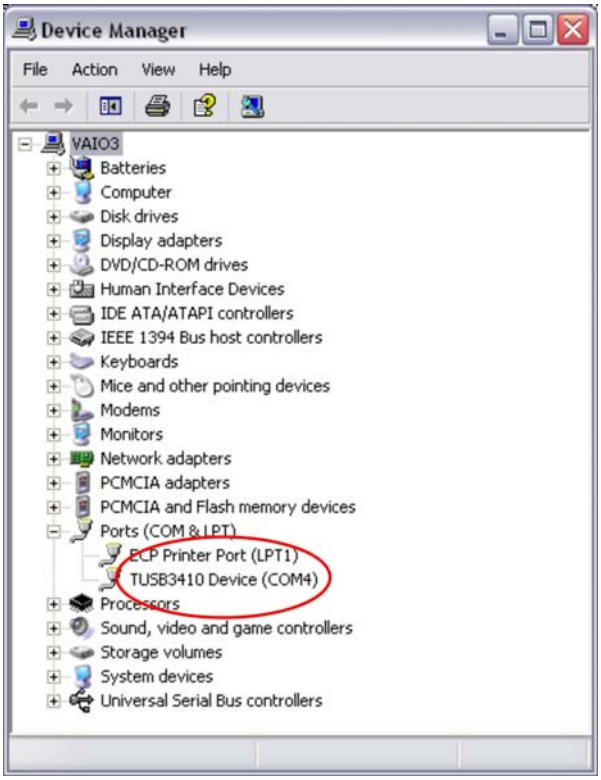


Figure 5 Windows Device Manager

Note Write down the Com Port that is being used for the TUSB3410, this value will be required to run the HDK control program. In Figure 5 the COM port is shown as COM4.

NOTE: If the TUSB3410 Device is shown with a yellow exclamation point then the USB driver is not installed. To install it, disconnect the AMBE-3000™ HDK from the PC's USB port and re-run the setup.exe program contained in the swrc094.zip file. Then connect the AMBE-3000™ HDK to the PC's USB port power it up and allow MS Windows to find new hardware. When prompted for where the driver to install is located enter the following directory C:/Program Files/Texas Instruments Inc/TUSB3410 Single Driver Installer/Disk1.

Analog Audio I/O

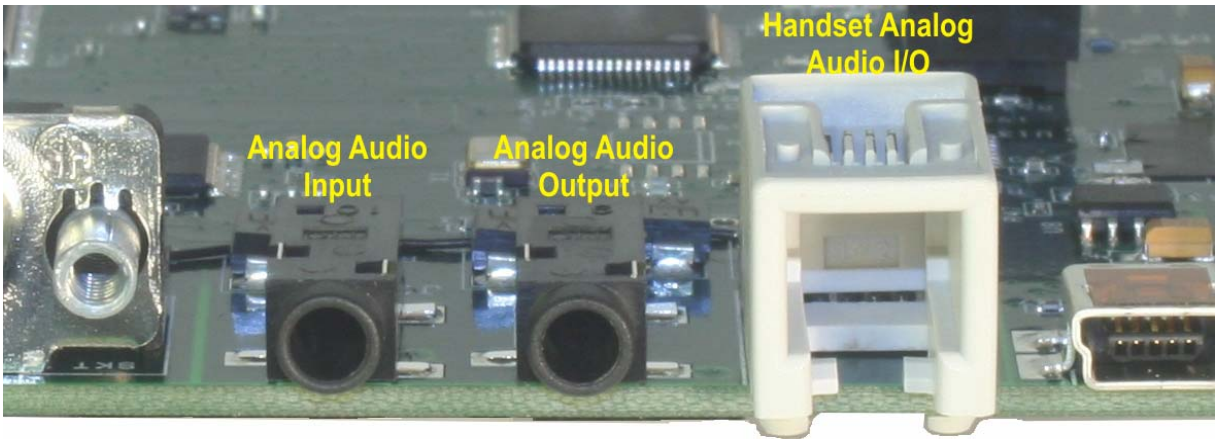


Figure 6 Audio Connections

Handset

If a handset is used instead of the 2 wire interface, use a standard telephone handset to connect to the RJ11 handset connector. Be sure that the handset cord is less than 12 inches long (included in the optional accessories kit) when not stretched. This will help reduce noise from being introduced into the voice signal. The AMBE-3000™-HDK Development Board always outputs the audio to both the 4-Wire and Handset output regardless of which voice source is selected.

3.5mm Jacks

The AMBE-3000™-HDK Development Board provides two 3.5 mm jacks (see Figure 6 Audio Connections) for the input and output of analog mono audio. A typical analog audio input connection for the HDK would be to connect the audio Line output of an audio component such as, a Digital Tape, player or even a PC sound card output to the Analog Input jack (audio cables not included) of the AMBE-3000™-HDK Development Board. The AMBE-3000™-HDK Development Board outputs the analog signal on the output 3.5 mm jack that may be connected to an amplifier or Audio In jack on a PC sound card. The unit always outputs the audio to both the 4-Wire and Handset output regardless of the voice source selected.

RS-232 Connections

There are two RS-232 I/O connections on the HDK board. (see Figure 7 RS-232 Serial Connections) Connector P2 (µ-controller RS-232) is the Input/Output that can be connected to the HDK's P1 connector using a null modem jumper cable to utilize the AMBE-3000™ Vocoder Chip's UART Interface. Alternatively, the P2 connector can be used to communicate to another HDK board's P2 connector for full duplex communications between two HDKs. This interface transfers data to/from the MSP µcontroller. The second serial port Connector P1 (AMBE-3000™ Vocoder Chip RS-232) on the HDK connects directly to/from the UART interface of the AMBE-3000™ Vocoder Chip.

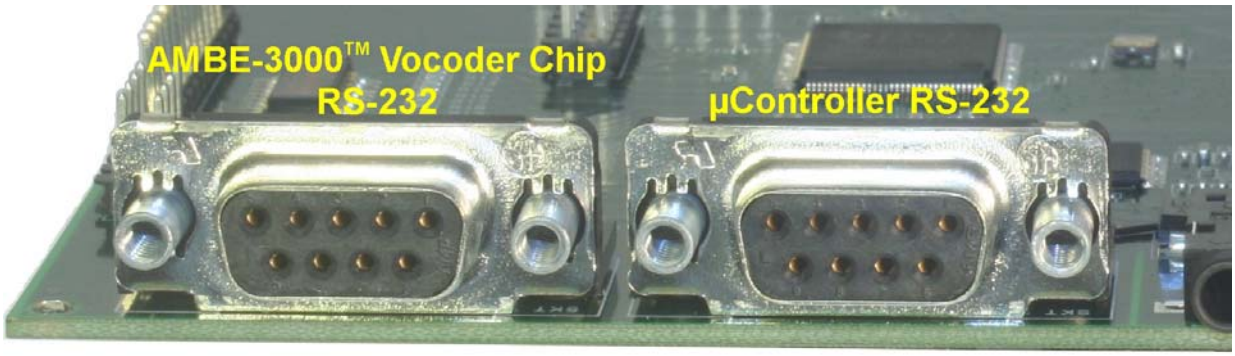


Figure 7 RS-232 Serial Connections

µ Controller RS-232 Connection (P2)

The P2 connection on the HDK Board is an asynchronous RS-232 interface for connecting directly to a serial device or another HDK Board. The P2 connector is connected to the µ-controller on the HDK. To connect the µ-controller to the UART Interface of the AMBE-3000™ Vocoder Chip a null modem serial cable is used between P1 and P2.

To connect two HDK boards together the device must be put into "Dual-HDK Mode" and P2 of one board is connected to P2 of the other board using a RS-232 Null Modem Cable. When two HDK boards are connected together to communicate, each converts the input analog speech into digital speech samples, encodes the speech using the selected vocoder rate and then sends the compressed bit stream out as serial data packets over the RS-232 interface. Simultaneously, the compressed bit stream from the other HDK are read in from the RS-232 interface and decoded back into digital speech samples. The decoded samples are converted back into analog speech via the codec whose output is sent to both the handset and RCA line-level output connections.

AMBE-3000™ Vocoder Chip RS-232 (P1)

The RS-232 Packet interface (P1) is connected to the UART interface of the AMBE-3000™ Vocoder chip (see AMBE-3000™ User's Manual section 2.5.2). The UART signals of the AMBE-3000™ are put through a RS-232 receiver/driver so that the user can connect directly to a terminal or terminal emulator on a personal computer. To set up this connection plug a RS-232 cable into the P1 connector on the HDK and plug the other end into your terminal (or one of the serial ports on your PC if you are using an emulator) and set the terminal up for 115,200 baud, eight bits, no parity, one stop bit, and no flow control. When using this interface in "UART Loopback Mode" a jumper cable must be connected between P1 and P2.

HDK List of Headers

The HDK provides a variety of Headers, connections and jumpers (see Figure 8 Header Test Points, Connections and Jumpers).

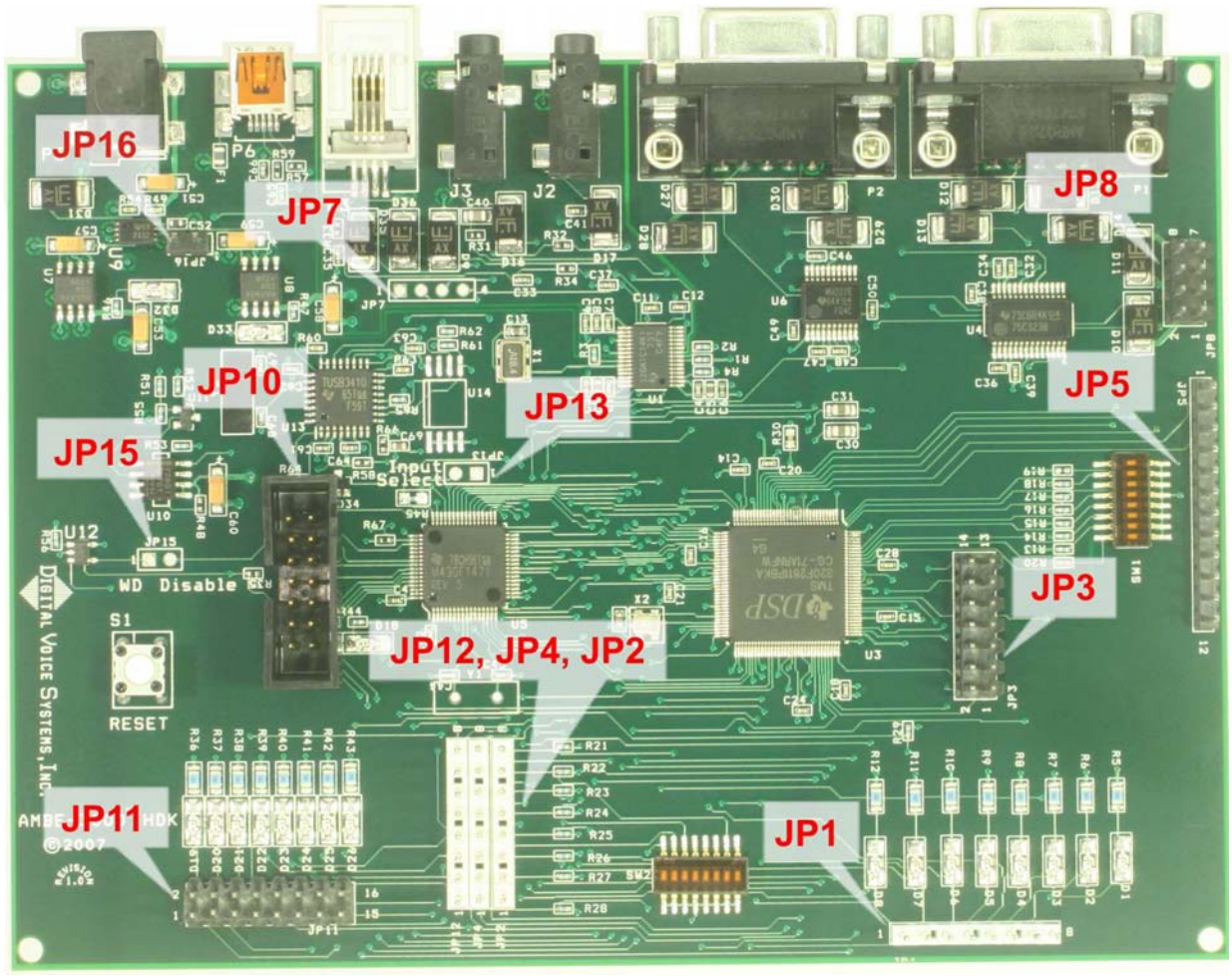


Figure 8 Header Test Points, Connections and Jumpers

HDK Headers			
Item	Header # of Pins	Name	Description
JP1	Header 8x1	LED Indicators	HDK board status indicators
JP2	Header 8x1	HDK Configuration	Jumpers to set board options
JP3	----	----	Not Used
JP4	Header 8x1	HDK Configuration	Jumpers to set board options
JP5	Header 2x1	Serial Data	AMBE-3000™ Chip Serial I/O
JP7	Header 4x1	----	N/A
JP8	Header 7x2	UART	Output of the UART
JP10	Header 7x2	JTAG	Connection for the µ controller
JP11	Header 8x2	µ controller LED's	HDK board status indicators
JP12	Header 8x1	HDK Configuration	Jumpers to set board options
JP13	Header 2x1	Codec Input Select	Sets Codec selection
JP15	Header 2x1	WatchDog	N/A
JP16	Header 2x1	USB Power	Not Used

Table 2 HDK List of Headers

HDK Test Points

HDK Board Header Test Points			
Item	Header # of Pins	Name	Description
JP1	Header 8x1	LED Indicators	HDK board status indicators
JP5	Header 2x1	Serial Data	AMBE-3000™ Chip Serial I/O
JP7	----	Handset IO	N/A
JP8	Header 7x2	UART	Output of the UART

Table 3 Header Test Points

JP1 LED Indicators Test Points

The JP1 Test points allow for monitoring of the status indicator LED's as described in Table 4 JP1 Test Points

JP1 Header		
Pin	Signal	Description
1	STAT7	Idle Indication
2	STAT6	Standby indication
3	STAT5	Reserved
4	STAT4	Reserved
5	STAT3	Run
6	STAT2	Reserved
7	STAT1	Reserved
8	STAT0	Reserved

Table 4 JP1 Test Points

JP5 Header Serial Interface Test Points

The JP5 Header provides access to the AMBE-3000™ Vocoder chip's Multichannel Buffered Serial Port (McBSP) Interface. When the HDK is in Codec Mode the McBSP interface is used for speech data and it is not available for packet data. In Packet Mode the McBSP interface is used for both speech data and packet data.

JP5 Header			
Pins	HDK Signal Name	AMBE-3000™ Pin Number	AMBE-3000™ Signal Description
1	SER_CHAN_TxD	19	Serial Transmit Data Output
2	GND		Ground
3	SER_CHAN_RxD	18	Serial Receive Data Input to the AMBE-3000™
4	GND		Ground
5	SER_CHAN_CLKR	21	Serial Receive Clock Input
6	SER_CHAN_CLKX	23	Serial Transmit Clock Output
7	GND		Ground
8	SER_CHAN_FSR	24	Serial Receive Frame Input
9	SER_CHAN_FSX	22	Serial Transmit Frame Output
10	GND		Ground
11	GND		Ground
12	GND		Ground

Table 5 JP5 Serial Test Points

JP7 Handset Analog Audio I/O Test Points

Handset I/O Test Points	
Pin #	Signal Description
1	Connected to Ground
2	Analog Out P1
3	Speaker Out
4	Microphone In/DC Microphone Bias out

Table 6 Header I/O Test Points

JP8 Header

JP8 Header		
Pins	Signal	Signal Description
1		Not Used
5		
2, 3, 4, 6, 7, 8		

Table 7 JP8 Serial Data

Header Connections

HDK Board Header Connections		
Item	Header # of Pins	Description
JP3	Header 7x2	Reserved
JP10	Header 7x2	JTAG Connection for the µ controller

Table 8 Header Connections

JP10 Header µController JTAG

The MSP430 JTAG connector is 2x7 pins with 0.1" step that follows the TI recommended JTAG layout. PIN1 is marked with square pad on bottom. MSP430-JTAG has built-in target board voltage follower and the JTAG voltage levels follow the MSP430 target board voltage, so the target may be powered with voltage between 2.7 and 3.6 V (if the target voltage is under 2.7V Flash memory cannot be programmed).

More information on the MSP430 JTAG can be found on Texas Instruments web site www.ti.com

Test points allow the user to access the data to and from the AMBE-3000™ Vocoder Chip. By connecting to these test points the user can monitor the data flow and to understand the operation of the chip. For more detailed explanation of the I/O signal, refer to the AMBE-3000™ Vocoder Chip Users manual.

JP10 Header (MSP430 JTAG)		
Pins	Signal	Signal Description
1	TDO/TDI	
2	VCC	
3	TDI/TCLK	
5	TMS	
6	NC	
7	TCK	
11	Resetn	
4, 8, 9, 10, 12, 14	GND	Ground
13	NC	No Connection

Table 9 JP10 MSP430 JTAG

HDK Board Status Indicator LEDs

AMBE-3000™-HDK Development Board uses LEDs' as a convenient way to display the current condition of Audio I/O, vocoder and communications channel to the operator.

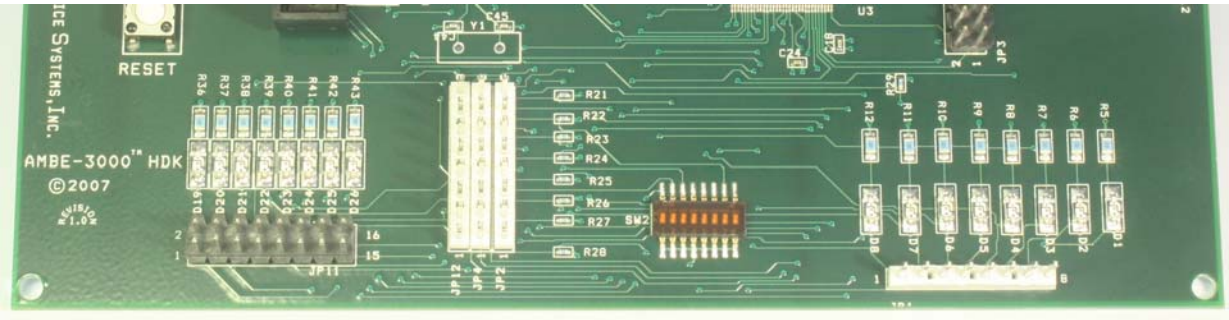


Figure 9 LEDs

The LED indicators indicate the status of the HDK board as follows

LED ID #	Description (when LED ON)
D1	Idle
D2	Low Power / Standby
D3	Reserved
D4	Reserved
D5	Indicates Encoder/Decoder Activity
D6	Reserved
D7	Reserved
D8	Reserved
D18	µ-controller power is active

D32	3.3 V Power on
D33	3.3 V Power on

LED Numbers	23	24	25	26
IDLE Mode				X
Codec Mode				
Codec Mode PPT		X		
Codec Mode PPT Passthru		X		X
Codec Mode UART		X	X	
Codec Mode UART Passthru		X	X	X
Packet Mode				
Packet Mode PPT			X	
Packet Mode UART			X	X
Loopback Mode				
Loopback Mode PPT	X			
Loopback Mode PPT Passthru	X			X
Loopback Mode UART	X		X	
Loopback Mode UART Passthru	X		X	X
A3kdirect	X	X	X	
Dual HDK Mode with Skew ON	X	X		X
Dual HDK Mode with Skew OFF	X	X		

Table 10 Board Status LED's

Note: X indicates LED is On. (LED's D19, D20, D21 and D22 are not used.)

HDK Configuration

Overview

The AMBE-3000™ Vocoder settings are determined by both the DIP switches and Jumper positions. The Dipswitch positions are always read upon board power up or after the Reset Button is pressed.

Board Reset

When the AMBE-3000™ HDK reset switch is pressed the HDK goes through the following sequence:

1) The MSP is reset
2) The MSP resets the AMBE-3000™ Vocoder chip
3) The MSP takes the AMBE-3000™ Vocoder chip out of reset
4) The codec is controlled by AMBE-3000™ Vocoder chip. The AMBE-3000™ Vocoder chip holds the codec in reset until the Codec Interface is activated.

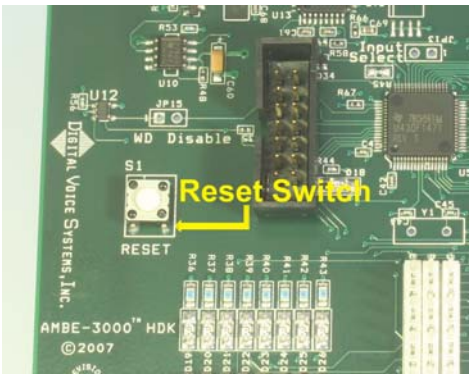


Figure 10 Reset Switch

AMBE-3000™ Vocoder Chip Configuration via Dip-Switches

The hardware DIP switches allow the user to set one of 64 standard AMBE-3000™ Vocoder Chip rates and configure the chips features. In order for a new setting to take effect, the Reset Switch must be pressed or the power to the board cycled off/on.

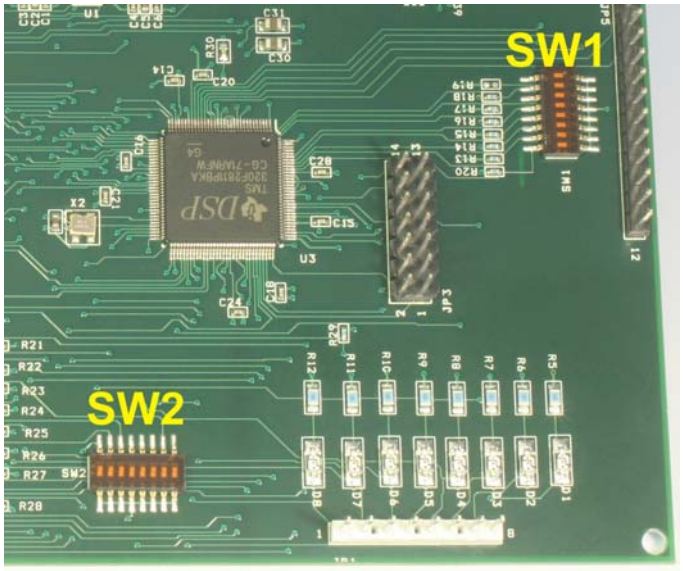


Figure 11 Vocoder Settings Switches SW1 and SW2

Note: As viewed in Figure 11 Switch 1 is set to "ON" when the white switch is positioned to the left and Switch 2 is set to "ON" when the white switch is in the up position.

Slide Dip-Switch Settings

Board Switches			
Item	Name	Position	Description
SW1	Echo Suppressor Control	1	Enable (Position OFF) / Disable (Position On)
	Echo Canceller Control	2	Enable (Position OFF) / Disable (Position On)
	Bit Rate 5	3	Bit Rate Selection See Table 23
	Bit Rate 4	4	
	Bit Rate 3	5	
	Bit Rate 2	6	
	Bit Rate 1	7	
	Bit Rate 0	8	
SW2	PARITY ENABLE	1	Parity Enable (Position Off) / Disable (Position On)
	Boot up mode	2	See Table Table 19 HDK Boot-up Mode Selection
	Boot up mode	3	
	Boot up mode	4	
	ScomRate0 (LSB)	5	Sets the AMBE-3000™ UART Baud Rate See Table 12
	ScomRate1	6	
	ScomRate2 (MSB)	7	
	STAT/CONFIG0	8	Reserved

Table 11 Board Dip Switches

Vocoder Rate Selection

There are a three ways to configure the encoding/decoding rate for the AMBE-3000™ HDK. Hardware switches (See Table 11 Board Dip Switches) allow the user to configure one of 64 standard rates. The user is able to choose a rate through the PC interface when the HDK is attached to a PC via USB. The user can recompile the AMBE-3000™ HDK source code to achieve any rate that they require.

After the HDK is reset, it resets the AMBE-3000™ Vocoder Chip. When the AMBE-3000™ Vocoder Chip comes out of reset, the rate is selected via the configuration pins as shown in Table 12 AMBE-3000™ Vocoder Chip UART Baud Rate Selection. The rate may be subsequently changed via software by sending an appropriate packet to the AMBE-3000™ Vocoder Chip.

AMBE-3000™ Vocoder Chip UART Interface Baud Rate Selection

In all modes except A3KdirectMode the baud rate must be sent to 460,800 baud.

Baud Rate (baud)	Position 7	Position 6	Position 5
28,800	ON	ON	ON
57,600	ON	ON	OFF
115,200	ON	OFF	ON
230,400	ON	OFF	OFF
460,800	OFF	ON	ON
921,600	OFF	ON	OFF

Table 12 AMBE-3000™ Vocoder Chip UART Baud Rate Selection

HDK Configuration Jumpers

Slide switches and jumpers provide control of configuration parameters for maximum flexibility of vocoder features.

HDK Board Configuration Jumpers		
Item	Header	Description
JP2	8x1	Enables AMBE-3000™ UART Rate Selection via Switch 2
JP4	8x1	Connects to AMBE-3000™ to set UART Rate
JP12	8x1	Enables AMBE-3000™ UART Rate Selection via µ-controller
JP11	8x2	Enables the HDK board status indicators LED's to be controlled by the µ-controller
JP13	2x1	Analog Audio I/O selection
JP16	2x1	Not Used
JP15	2x1	"WD Disable" Reserved

Table 13 Jumper Header Connectors

JP2, JP4 and JP12 Headers Jumpers

Jumpers between JP4 and JP2 are used to enable the AMBE-3000™ UART Rate Selection via Switch 2. The following Jumpers are required. Jumpers between JP4 and JP12 are reserved and not used.

JP4 Header	Jumper	JP2 Header
Pin		Pin
1	Installed	1
2	**NOT** Installed	2
3	**NOT** Installed	3
4	**NOT** Installed	4
5	Installed	5
6	Installed	6
7	Installed	7
8	**NOT** Installed	8

Table 14 JP2 to JP4 Header Jumpers

JP11 Header LED Indicators

The JP11 header enables LEDs D19 through D26 to be active. These LEDs are used to indicate the current status on the HDK Mode. All Jumpers should be installed on this header.

JP11 Header	
Pins	Jumper Installed Description
1 - 2	Enables LED D19
3 - 4	Enables LED D20
5 - 6	Enables LED D21
7 - 8	Enables LED D22
9 - 10	Enables LED D23
11 - 12	Enables LED D24
13 - 14	Enables LED D25
15 - 16	Enables LED D26

Table 15 JP11 Enable LED Indicators

JP13 Header CODEC_Input Select

This jumper allows the user to select between the 4-wire Line In (RCA 3.5mm plug) or the 2-wire (handset) analog audio I/O.

JP13 Header		Description	
Pins	Signal	Jumper **NOT** Installed	Jumper Installed
1 - 2	CODEC_INPUT SEL	Audio Source is Handset	Audio Source is Line In

Table 16 JP13 Codec Input Selection

JP15 Header WD Disable

Reserved – Not currently active

JP15 Header		
Pins	Signal	Description
1 - 2		Jumper **NOT** Installed

Table 17 JP15 WD Disable

JP11 Header USB Power

The HDK can be powered from the Power connector P5 only.

JP16 Header		
Pins	Jumper **NOT** Installed	Jumper Installed
1 - 2	Use 5 Volts Power source from Power Connector P5	Not Used

Table 18 JP16 USB 5 Volt Power

Operation

Operating Modes

The HDK provides different operating modes to allow testing and evaluation of data to and from the AMBE-3000™ vocoder chip at various stages along the data path. This gives the user the opportunity to understand how the AMBE-3000™ vocoder chip needs to be implemented and how to use the HDK as a tool to verify a new design.

The user can select what mode the HDK will be in on start-up or after a reset through setting of Switch 2. See Table 19 HDK Boot-up Mode Selection. This allows the user to set the mode of the HDK without having to connect to a PC. If the use a PC is desired then switch SW2 must be set so that the HDK boot mode is set to IDLE.

Boot Up Mode	SW2 Switch Position		
	Position 4	Position 3	Position 2
Idle	OFF	OFF	OFF
Packet Mode	OFF	OFF	ON
Loopback Mode - PPT	OFF	ON	ON
Loopback Mode - UART	OFF	ON	OFF
A3kdirect Mode	ON	ON	OFF
Dual HDK Mode Skew ON	ON	OFF	OFF
Dual HDK Mode Skew OFF	ON	OFF	ON

Table 19 HDK Boot-up Mode Selection

The following is the list of operating modes:

HDK Mode Description	
Option Command	hdkcom.exe Option Description
IDLE Mode --- The HDK is ready to accept commands from the PC.	
`-mode idle`	Sets the HDK mode to Idle
Codec Play/Record Mode* --- The HDK plays an audio file out the analog audio output, or record the audio input to a file or do both at the same time.	
`-mode codec`	This sets the HDK to stay in Codec Play/Record mode and the HDK is ready to process audio
`-play`	Send a file to the HDK to be decoded and heard through the analog output.
`-record`	To record the audio input to an encoded file
`-playrecord`	Send an encoded speech file to the HDK to be decoded and played through the analog output while simultaneously recording an encoded file using the analog input as an audio source.
Packet Mode*--- The HDK is ready to encode a PCM file and save it to the PC, or Decode an encoded file and save it to the PC, or do both at the same time.	
`-mode packet`	This sets the HDK to stay in packet mode and the HDK is ready to process files

-enc	To encode a PCM file and save it to File on the PC
-dec	To decode an encoded file and save it to a PCM File
-encdec	To encode a PCM file then decode it to a PCM File and save it on the PC
Loopback Mode --- Analog speech input from the handset or RCA jack input connections gets encoded by the AMBE-3000™ Vocoder chip looped through either it's PPT or UART interface and played back out the analog audio outputs.	
-mode loopback	Sets the HDK mode to loopback
A3kdirect Mode --- directly connects the AMBE-3000™ Vocoder Chip's UART Interface to a PC using the RS-232 port interface (P1) Note: a Serial to USB adapter is required.	
-mode a3kdirect	Sets the HDK mode to a3kdirect
Dual HDK Mode --- directly connects two AMBE-3000 HDK's together using the RS-232 channel interface (P2).	
-mode dualhdkskew	Sets the HDK mode to Dual HDK Mode with Skew ON
-mode dualhdk	Sets the HDK mode to Dual HDK Mode with Skew OFF

Table 20 HDK Modes

*Note: To run in Codec Play/Record or Packet Modes start in Idle Mode. When the hdkcom.exe program is run with one of the process options –enc, -dec, -encdec, -play, -record, -playrecord, the HDK will automatically switch into either Codec or Packet Mode. After the file is processed the HDK will automatically switch back into Idle mode.

HDK to AMBE-3000™ Vocoder Chip Interface

The USB interface on the HDK is used for board setup and control. The HDK provides access to the parallel and UART interfaces on the AMBE-3000™ vocoder chip. When running in Codec Play /Record Mode, Packet Mode or Loopback Mode the user can select either PPT or UART interface to use. If the UART is selected then a Null Modem Jumper cable between P1 and P2 is needed When running in a3kdirect Mode the HDK connects the UART Interface of the AMBE-3000™ Vocoder Chip to the P1 serial port and needs a "serial to USB adapter" to achieve the required data rate. When running in Dual HDK Mode the HDK uses the Parallel Interface of the AMBE-3000™ Vocoder Chip.

HDK to AMBE-3000™ Vocoder Chip Interface Selection

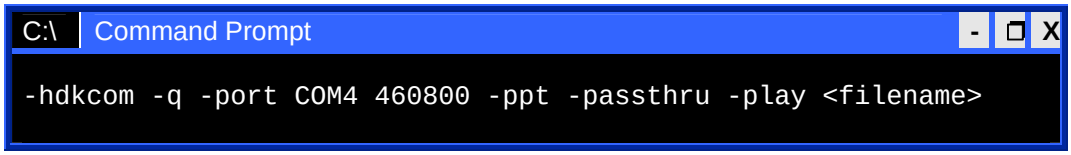
HDK Interfaces Description	
Option Command	Connection
PPT Interface	
-ppt	When using the PPT Interface in Codec Play /Record Mode, Packet Mode or Loopback Mode, a USB Cable to the PC is required for configuration and control
	When using the PPT Interface in Dual HDK Mode, a USB Cable to the PC is required and Null Modem Cable is required to connect P2 of HDK board "A" to P2 of HDK board "B"
UART Interface	
-uart	When using the UART Interface in Codec Play/Record Mode, Packet Mode or Loopback Mode a Null Modem Jumper Cable is required to connect P1 to P2
	When using the UART Interface in a3kdirect Mode a standard serial cable is required to connect P1 to a COM Port on a PC (a "serial to USB adapter" may be used)

Table 21 HDK AMBE-3000™ Interfaces

The `–ppt` and `–uart` command options may be combined with any of the command option except `–dualhdk` and `-dualhdkskew`.

Data Pass Through

The HDK provides the ability to pass analog speech input from the handset or RCA jack input connections as raw PCM data through the AMBE-3000™ Vocoder Chip with out performing any processing of the data. Passthru may be used in either Codec Mode or Loopback Mode. This enables the user to gain an understanding of the data path for testing and verification.
A command line example to set the HDK in Codec Mode Passthru follows:



where

`-q` stops the DVSI Licensing Notice from being displayed

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip

`-passthru` sets the HDK to pass the data through the AMBE-3000™ Vocoder chip

`-play` sets the AMBE-3000™ vocoder chip into codec mode.

`<filename>` file to be played through codec mode.

HDK Software

The AMBE-3000™ HDK Vocoder board is set-up, controlled and operated from a PC. In order for the PC to work with the HDK a USB cable must be used and USB drivers must be installed. See the USB Connection Section on how to install the USB drivers. Once the connection between the PC and the HDK is established the HDK software should be installed on the PC.

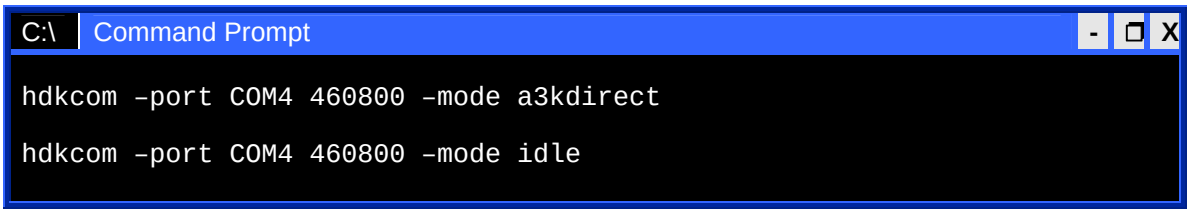
The AMBE-3000™-HDK Development Board kit includes a CD with a PC executable program (hdkcom.exe). This software should be copied from the CD into a user created directory located on a C-drive named C:\hdk. This executable program enables the user to, control the HDK mode, compress and record analog speech input data to a PC via the USB interface, or decode a previously encoded file and play it out of the analog outputs.

Installing HDK program file On Windows Vista/XP

- Step 1 Create a folder named C:\HDK on the PC.
- Step 2 Copy the entire contents of the CD provided with the HDK into this folder.
- Step 3 When the copying of all the contents is finished go to the C:\HDK directory and unzip tv.zip file to C:\HDK\tv. This compressed data file contains test vectors that may be used for vocoder testing.
- Step 4 Before continuing on review all of the documentation in the C:\HDK\Docs directory.

Step 5 Verify correct operation of the board by taking the board out of Idle Mode (default) and setting the board into a3kdirect Mode and return it back to idle mode. When the HDK is in a3kdirect mode LEDs D19 through D26 will light, demonstrating that the HDK interface is functioning.

Example - To set the board into a3kdirect Mode and then set the HDK board back to the default Idle Mode



where:

`COM4` is the COM port on the PC that the HDK will communicate on

`460800` is the baud rate of the PC connection

`-mode a3kdirect` is to set the board into a3kdirect Mode (D19 – D26 LED's ON)

`-mode idle` is to set the board back into idle Mode (only D26 LED ON)

Also included on the HDK CD disk are sample speech and compressed speech files as described below:

<*file name*>**.pcm** -- (pcm format audio file 16 bit audio file sampled at 8kHz.)
<*file name*>**.pcma** -- (a-law format audio file 8 bit audio file sampled at 8kHz.)
<*file name*>**.pcmu** -- (µ-law format audio file 8 bit audio file sampled at 8kHz.)

<*file name*>**-r**<*rate index #*>**.bit** -- (encoded data from a PCM file)
compressed speech files from a **.pcm** (PCM) format file, that are encoded (recorded) at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r37.bit** is a compressed data file encoded at rate index 37 which is a data rate of 2400bps.

<*file name*>**-r**<*rate index #*>**.bita** -- (encoded data from an a-law file)
compressed speech files from a .pcma (a-law) format file, that are encoded (recorded) at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r39.bit** is a compressed data file encoded at rate index 39 which is a data rate of 3600bps.

<*file name*>**-r**<*rate index #*>**.bitu** -- (encoded data from an µ-law file)
compressed speech files from a .pcmu (µ-law) format file, that are encoded (recorded) at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r42.bit** is a compressed data file encoded at rate index 42 which is a data rate of 4800bps.

<*file name*>**-r**<*rate index #*>**.pcm** -- (encoded/decoded PCM file)

files from a .pcm (PCM) format file, that are encoded and then decoded to a PCM file at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r37.pcm** is a PCM file encoded/decoded at rate index 37 which is a data rate of 2400bps.

<*file name*>**-r**<*rate index #*>**.pcma** -- (encoded/decoded a_law file)
files from a .pcma (a-law) format file, that are encoded and then decoded to an a-law file at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r39.pcm** is an a-law file encoded/decoded at rate index 39 which is a data rate of 3600bps.

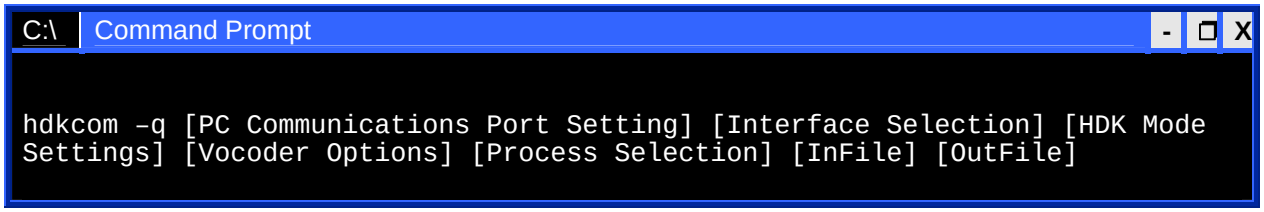
<*file name*>**-r**<*rate index #*>**.pcmu** -- (encoded/decoded μ_law file)
files from a .pcmu (μ-law) format file, that are encoded and then decoded to an μ-law file at a data rate as indicated by the rate index number that follows the **-r**. For example, **dvsi-r42.pcm** is an a-law file encoded/decoded at rate index 42 which is a data rate of 4800bps.

In addition to the sample files several sample scripts are provided to facilitate testing operations.

Running the HDK Control Software

All Control of the HDK is performed using a command prompt window and a command line interface. The file hdkcom.exe is the control program that is run for board set-up and operation. To run the program, open a command prompt window and change to the directory (C:/hdk) that has the hdkcom.exe program file in it and type in the desired command using the following structure:

hdkcom command description


C:\
Command Prompt
hdkcom –q [PC Communications Port Setting] [Interface Selection] [HDK Mode Settings] [Vocoder Options] [Process Selection] [InFile] [OutFile]

where:

-q is an optional switch that may be use to prevent the DVSI Licensing Notice from being printed to screen after the command has been processed.

[PC communications port settings]
Specifies which COM Port the HDK USB interface is using. See USB Connection Section for how to determine the COM Port Value. This value is always followed by the Baud rate value and is used in every command line.
PC communications port settings format
`-port COM<#> <baud rate>`

[Interface Selection]
The interface selection option specifies which AMBE-3000™ Vocoder chip interface (UART or Parallel) is used to connect to the MSP μcontroller. See Table 21 HDK AMBE-3000™ Interfaces
Interface Selection format
`-uart`
`-ppt`

[HDK MODE Setting]

There are 8 HDK mode options to select from. The HDK modes are described in Table 20 HDK Modes

HDK Mode settings Format

`-mode <selection>` where selection may be one of the following

`idle` with this selection the PC switches the HDK into an idle mode where is ready to receive setup and control commands

`codec`
with this mode the PC controls the HDK to set the AMBE-3000™ vocoder chip into codec mode. The HDK is then able to play an audio file out the analog audio output, or record the audio input to a file or do both at the same time. Using this selection the HDK will keep the AMBE-3000™ in Codec mode until switched out via a new selection.

`packet`
with this mode the PC controls the HDK to set the AMBE-3000™ vocoder chip into packet mode. The HDK is then able to encode a PCM file and save it to the PC, or Decode an encoded file and save it to the PC, or do both at the same time. Using this selection the HDK will keep the AMBE-3000™ in Packet mode until switched out via a new selection.

`loopback`
for this mode, the PC controls the HDK to configure the AMBE-3000™, into codec mode. The AMBE-3000™ encodes speech samples received via the codec interface. Packets from the AMBE-3000 are received via the MSP and then sent back to the AMBE-3000™ for decoding. The decoded samples are output via the codec interface.

`dualhdk`
for this mode, the HDK configures the AMBE-3000™, and switches it to codec mode. The AMBE-3000™ encodes speech samples received via the codec interface. Packets from the AMBE-3000™ are received via the MSP and sent out over P2 which is assumed to be connected to another HDKs P2. Simultaneously the MSP receives channel packets from P2 and sends it to the AMBE-3000™, which decodes the packets. The decoded speech samples are output via the codec interface.

`dualhdkskew`
This mode is the same as dualhdk mode except that skew control is enabled on the AMBE-3000™. The AMBE-3000™ produces packets at the same rate which packets are received.

`a3kdirect`
for this mode, the HDK configures the AMBE-3000™ to operate in packet mode using the UART interface (P1). This allows packets to be sent directly to the AMBE-3000™ without having the MSP involved. For example, if P1 is connected to a PC, a custom program or a terminal program running on the PC can send/receive packets to/from the AMBE-3000™ vocoder chip

[Vocoder Options]

The HDK provides the ability to set the data rate and noise suppression of the AMBE-3000™ Vocoder chip.

Vocoder Options Format

`-r <"rate index#" or "custom rate words">`

where the `"rate index#"` sets the bit rate of the AMBE-3000™ encoder/decoder See Table 23 Standard Rate Table for AMBE-3000. Or if `"custom rate words"` are used to set the rate – the format must be six words in hexdecimal format separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-ns <state>`
where the noise suppression is either turned off (state=0) or on (state=1) (default=on)

`-passthru`
for this option, the PC controls the HDK to configure the AMBE-3000™, into codec mode. In this mode, incoming data to the AMBE-3000™, gets output without any encoding or decoding processing. Packets from the AMBE-3000™ are then sent to the appropriate interface depending on which interface is selected.

[Process Selection]
This is the selection of what process the HDK is to perform.
where selection may be one of the following:

`-enc` with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into packet mode and the speech packets that are sent from the <infile> get encoded. Channel packets are then sent back to the PC and the channel data is stripped from the packets and written to <outfile>. When complete, the HDK is switched into IDLE mode.

`-dec` with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into packet mode and channel packet data from the file <infile> is decoded. The data in the <infile> is expected to be in hard decision (8 bits per byte) format. Refer to the AMBE-3000™ Vocoder Chip Users Manual Section 6.9 CHAND field description. The speech packets are then sent back to the PC where the Speech data is extracted and written to the <outfile>. When complete, the HDK is switched into IDLE mode

`-decsd`
with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into packet mode and channel packet data from the file <infile> is decoded. The data in the <infile> is expected to be in 4-bit soft decision (2 bits per byte) format. Refer to the AMBE-3000™ Vocoder Chip Users Manual Section 6.9 CHAND4 field description. The speech packets are then sent back to the PC where the Speech data is extracted and written to the <outfile>. When complete, the HDK is switched into IDLE mode

`-encdec`
with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into packet mode and speech packets that are sent from the <infile> get encoded. Channel packets are then sent back to the PC and the channel data is stripped from the packets and written to <outfile>. When complete, the HDK is switched into IDLE mode.

`-play` with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into codec mode. Channel data from the file <infile> is used to create AMBE-3000™ Vocoder chip channel packets that are decoded and the resulting speech samples are sent to the codec interface. The data in the <infile> is expected to be in hard decision (8 bits per byte) format. Refer to the AMBE-3000™ Vocoder Chip Users Manual Section 6.9 CHAND field description. When all of the bits have been decoded, the HDK is switched into idle mode. The <outfile> is not used.

`-playsd`
with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into codec mode. Channel data from the file <infile> is used to create AMBE-3000™ Vocoder chip soft-decision channel packets that are decoded and the resulting speech samples are sent to the codec interface. The data in the <infile> is expected to be in 4-bit soft decision (2 bits per byte) format. Refer to the AMBE-3000™ Vocoder Chip Users Manual Section 6.9 CHAND4 field description. When all of the bits have been decoded, the HDK is switched into idle mode. The <outfile> is not used.

`-record <time (in seconds)>`
with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into codec mode and speech data from the audio input gets encoded. For each channel packet that is output by the HDK the PC extracts the channel data and writes it to the file <outfile>. The program will record for the number of seconds specified by the <time> decimal integer seconds. When complete, the HDK is switched into idle mode. The <infile> is not used.

`-playrecord`
with this selection the PC controls the HDK to set the AMBE-3000™ vocoder chip into codec mode, Channel data from the file <infile> is used to create AMBE-3000™ Vocoder chip channel packets that are decoded and the resulting speech samples are sent to the codec interface. At the same time and speech data from the audio input gets encoded. For each channel packet that is output by the HDK the PC extracts the channel data and writes it to the file <outfile>. When all the data from <infile> has been read, the HDK is switched into idle mode.

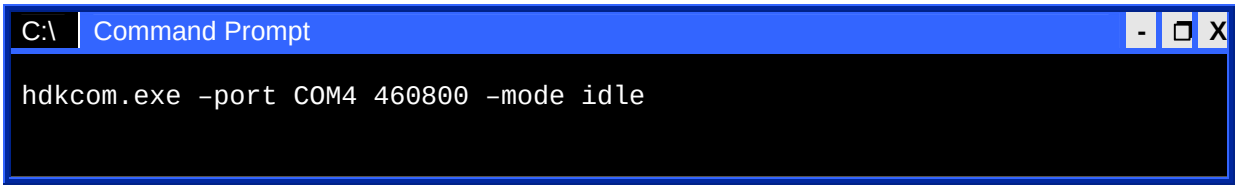
`[infile]` Name of the input file to use (if applicable to the specified mode)

`[outfile]` Name of the output file to use (if applicable to the specified mode)

Idle Mode

The HDK is factory set to start-up in Idle Mode. In this mode the HDK is ready play/record or encode/decode files using the AMBE-3000™Vocoder chip's PPT or UART Interface. The HDK can accept commands via the USB interface using the hdkcom.exe program. When the HDK is in idle mode D19 and D26 are on.

Idle Mode Command Example



where

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-mode idle` sets the HDK board into Idle Mode

Codec Play/Record Mode

When in Codec Play/Record Mode the HDK is capable of playing a file out the analog audio output, recording the audio input to a file or doing both at the same time. In this mode the HDK may be set to play (`-play`) audio, record (`-record`) audio or both play and record (`-playrecord`) at the same time.

Note: The hdkcom.exe program automatically switches the HDK into Codec Play/Record Mode (`–mode codec`) when the command line uses any one of these three options. After the file is played/recorded the HDK is automatically switched back into idle mode. If it is desired to keep the HDK in Codec Play/Record mode to be ready to process audio then the
`–mode codec`
option must be used in the command line.

Play File to Audio Output

`-play` is used to (decode) a previously recorded (encoded) (.bit) file stored on the PC. When the HDK receives the encoded (.bit) file over the USB interface it is processed by the AMBE-3000™ Vocoder Chip's decoder. This synthesized data bit stream is then converted into an analog signal using the onboard D-to-A and played out the handset / RCA jack outputs.

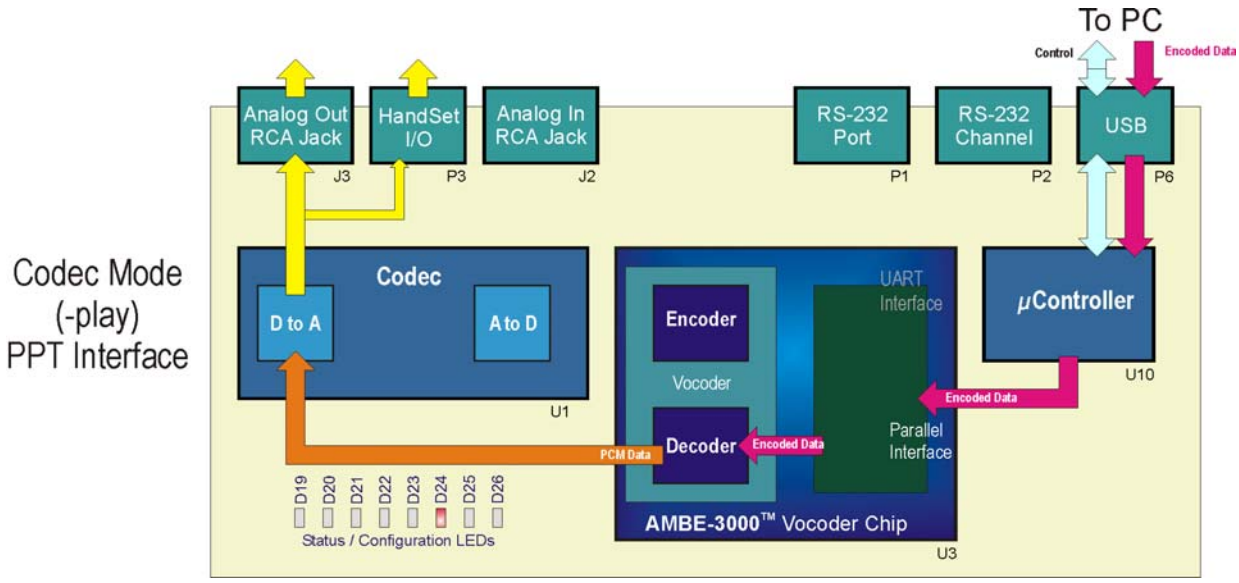
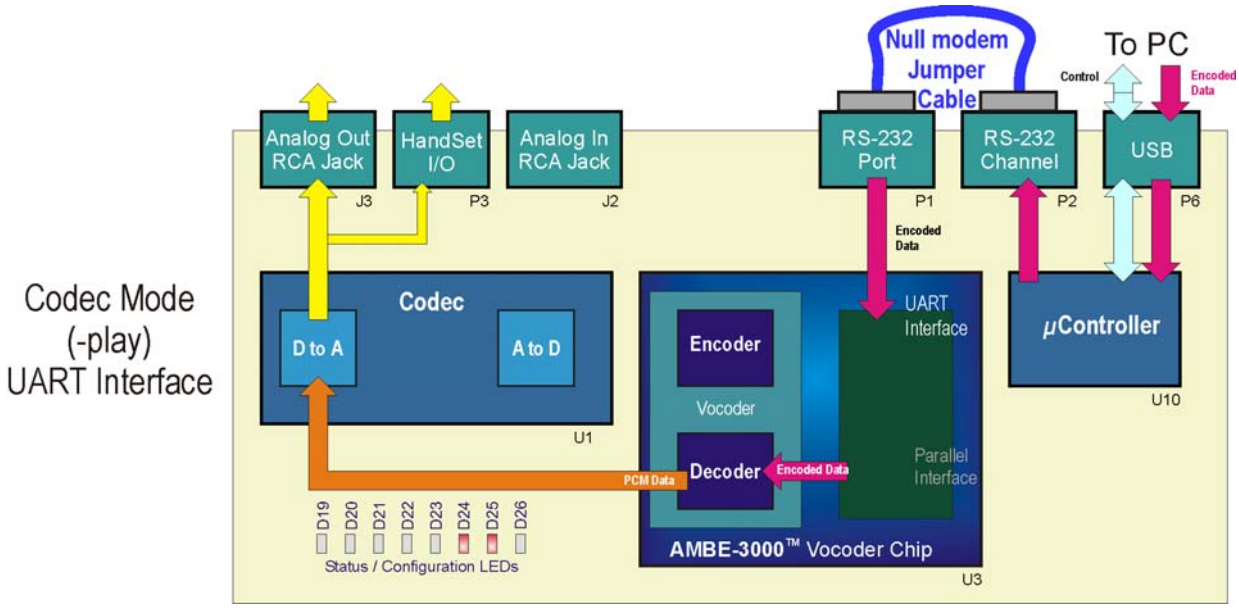


Figure 12 Play / Record -play Block Diagram

or



Codec Play Audio Output Command Example of playing an encoded (3600bps) file out the audio output

```
C:\ Command Prompt
hdkcom.exe –port COM4 460800 –uart or –ppt –r 39 -play dvsi36.bit
```

where

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`-r 39` is the rate index of the bit rate the file was originally encoded at. See Table 23 Standard Rate Table for AMBE-3000™. If it is desired to use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0448 0x0766 0x0000 0x0000 0x0000 0x6848
```

`-play` decodes the previously encoded file and plays it out the audio output

`dvsi36k.bit` is the name of the file to be played out the audio output

Record Input Audio to File

`-record` is used to perform real-time recording of analog speech from either the handset or line-in (depending on Jumper JP13). In the record mode the analog speech input is digitized then encoded by the AMBE-3000™ vocoder chip. The file is then saved on the PC (via the USB interface) as the file named (.bit suffix) in the command line. The file format for the encoded speech is 16 bit little endian.

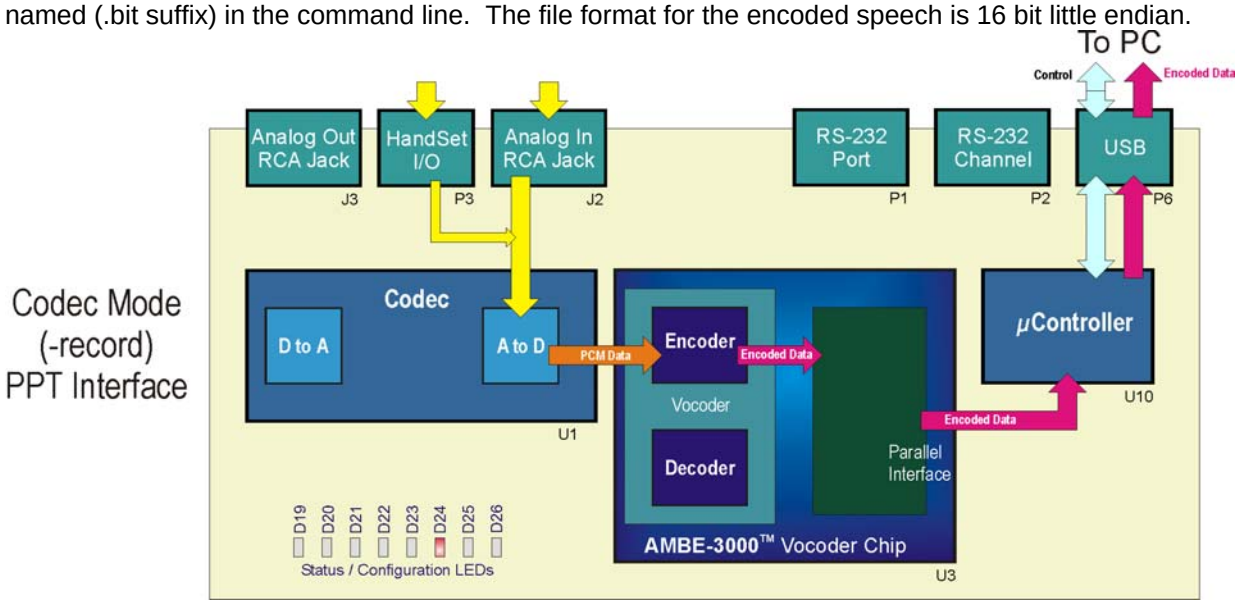
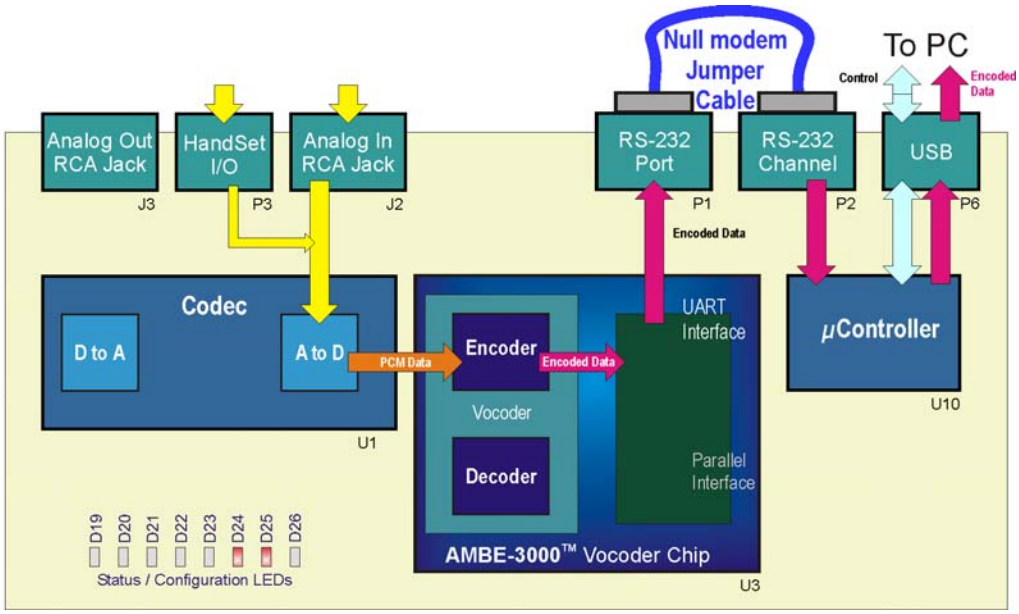


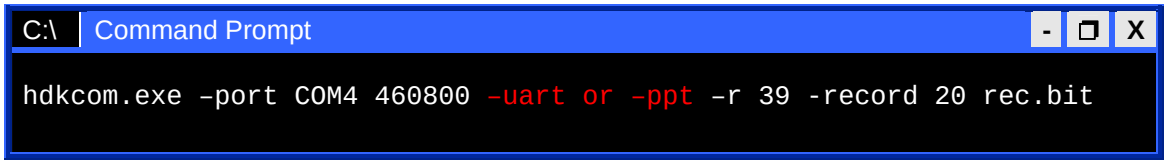
Figure 13 Play / Record -record Block Diagram

or

Codec Mode
(-record)
UART Interface



Codec RECORD Audio Input Command Example:



where

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`-r 39` is the rate index of the bit rate the file was originally encoded at. See Table 23 Standard Rate Table for AMBE-3000. If it is desired to use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0448 0x0766 0x0000 0x0000 0x0000 0x6848
```

`-record 20` encodes the audio input for 20 seconds and saves it to a file

`rec.bit` is the name of the file to be encoded from the audio input

Play/Record Audio

-`playrecord` is used to perform both record of the audio input and play a file out the audio output at the same time.

Codec Mode
(-playrecord)
PPT Interface

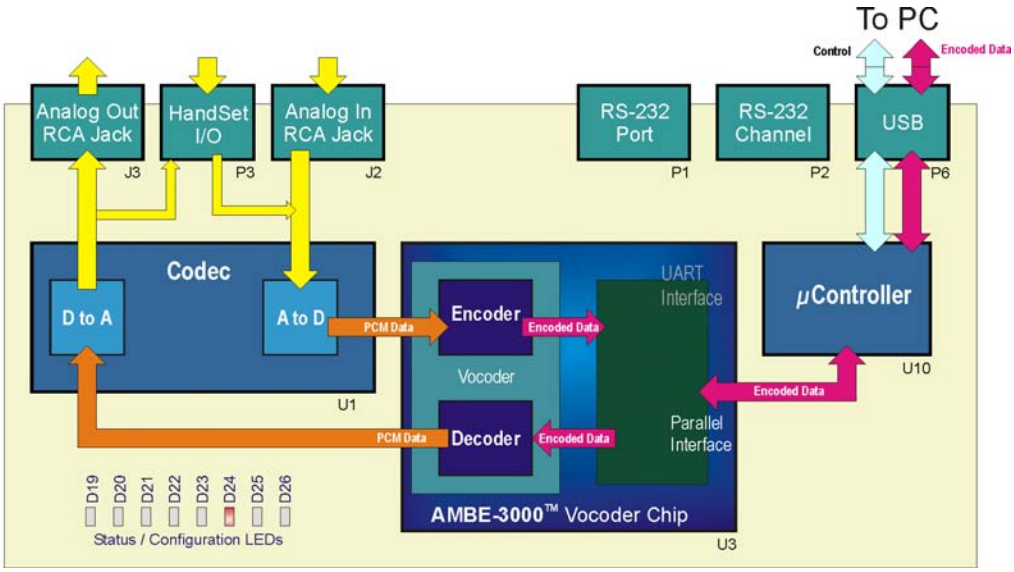
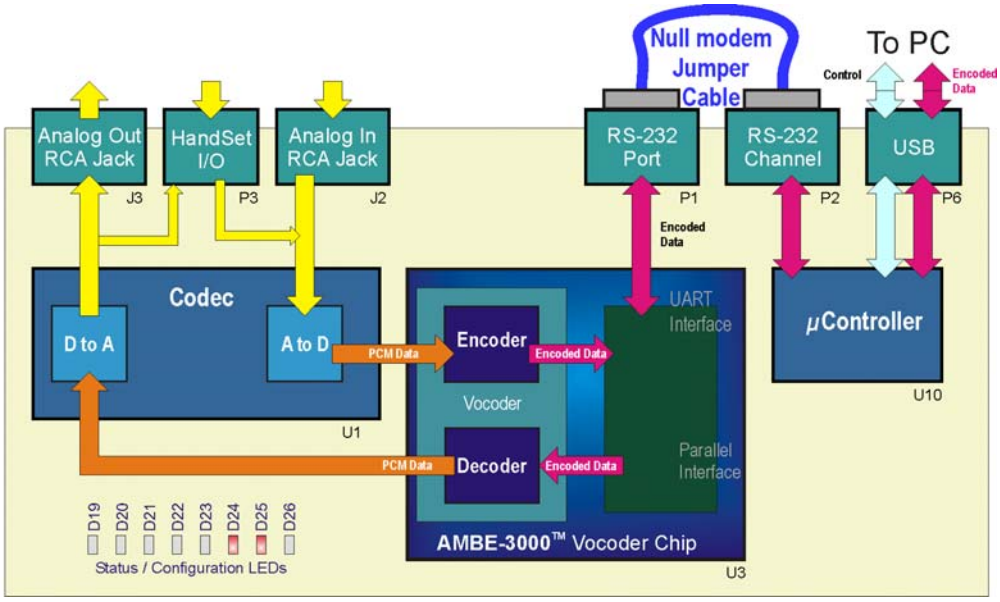


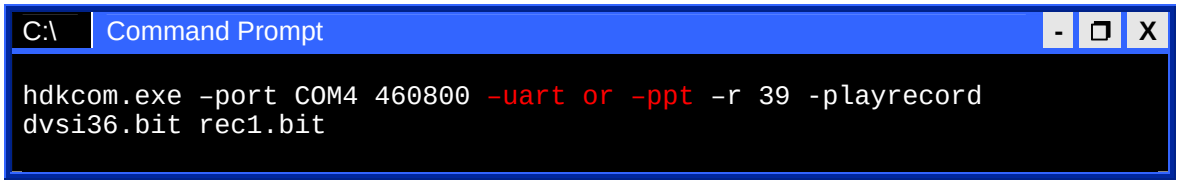
Figure 14 Play / Record -playrecord Block Diagram

or

Codec Mode
(-playrecord)
UART Interface



Codec PLAY/RECORD Audio Command Example:



`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`-r 39` is the rate index of the bit rate the file was originally encoded at. See Table 23 Standard Rate Table for AMBE-3000. If it is desired to use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0448 0x0766 0x0000 0x0000 0x0000 0x6848
```

`-playrecord` decodes the previously encoded file and plays it out the audio output and at the same time encodes the audio input and saves it to a file

`dvsi36.bit` is the name of the file to be played out the audio output

`rec1.bit` is the name of the encoded file from the audio input

Packet Mode

To encode / decode files to / from the PC via the USB interface the HDK has to be placed into Packet Mode. In Packet Mode the HDK may be set to decode (`-dec`) an encoded file to a PCM file, encode (`-enc`) PCM file to an encoded file or both (encode/decode) a file. In Packet Mode, the default setting for the HDK is to use the AMBE-3000™ vocoder chip parallel interface for processing packets.

Using the hdkcom.exe program it is not necessary to set the HDK into Packet Mode (`–mode packet`). The hdkcom.exe program will automatically switch the HDK into Packet Mode when the command line uses any one of these three options (`-dec`, `-enc`, `-encdec`). After the file is encoded/decoded or both to a file the HDK is automatically switched back into Idle mode. If it is desired to keep the HDK in Packet mode to be ready to process files, then the

```
–mode packet
```

option must be used in the command line.

Encode File
-enc is used to encode a file from the PC, the (.pcm suffix) file input to the HDK via USB interface must be 16-bit linear PCM data sampled at 8kHz. The file from the PC will be encoded by the AMBE-3000™ and then sent back to PC and saved as the (.bit) file as named in the command line.

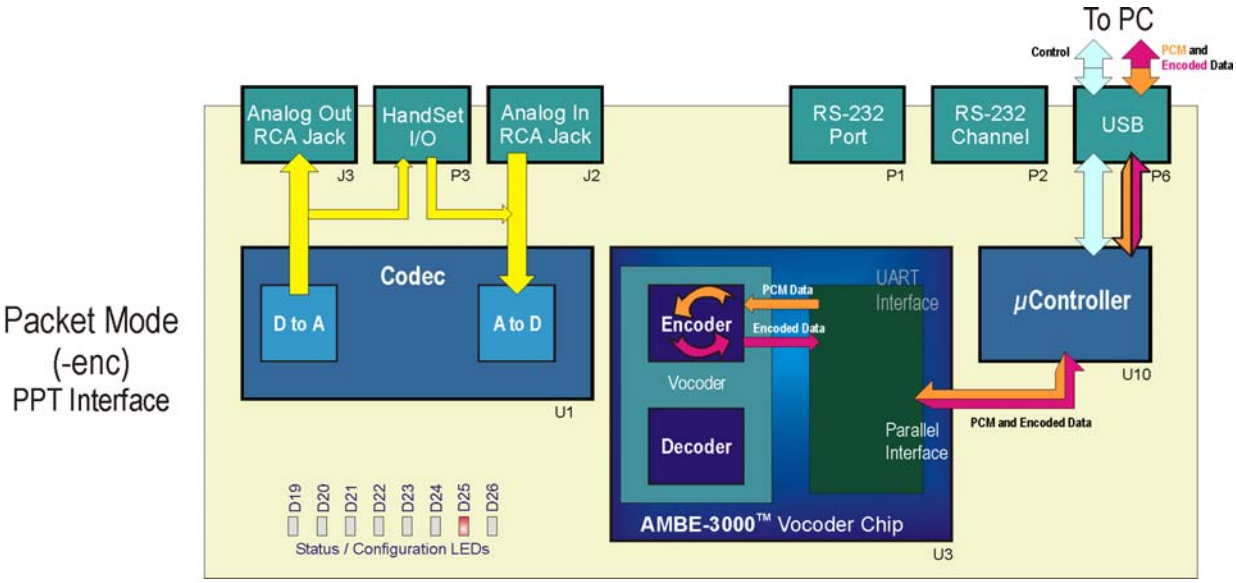


Figure 15 Packet Mode –enc PPT Interface Block Diagram

or

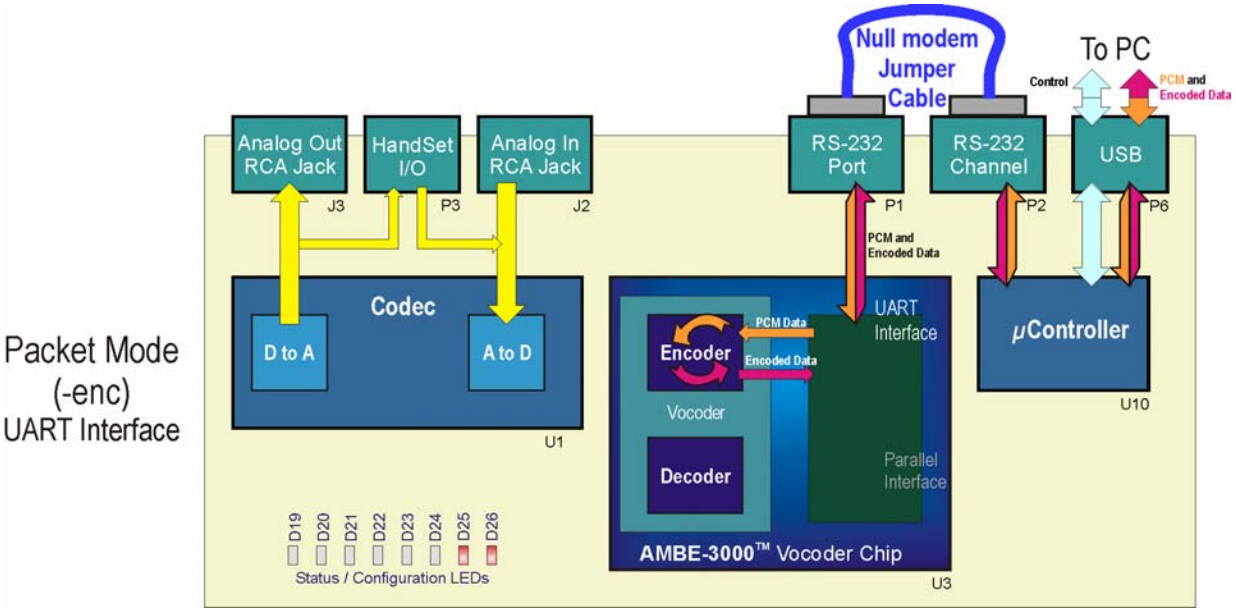


Figure 16 Packet Mode -enc UART Interface Block Diagram

Packet Mode Encode File Example

```
C:\ Command Prompt
hdkcom.exe –port COM4 460800 –uart or –ppt –r 39 -enc dvsi.pcm
dvsi36tst.bit
```

where

`COM4` is the COM port on the PC that the HDK will communicate on

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`-r39` is the rate index of the bit rate the file is to be encoded at 3600bps.

`-enc` encodes the PCM file and saves it to a file

`dvsi.pcm` is the name of the PCM file to be encoded

`dvsi36tst.bit` is the name of the file to be saved

To validate that the file was encoded correctly simply compare the created file `dvsi36tst.bit` with the similar file `dvsi36.bit` included on the HDK CD.
In the HDK directory use the following DOS command.

Decode File

-dec is used to decode a previously encoded (.bit) file from the PC, When the HDK receives the encoded (.bit) file over the USB interface it is processed by the AMBE-3000™ Vocoder Chip's decoder. The synthesized digital speech data is sent back to the PC via the USB interface and saved as the (.pcm suffix) file named in the command line.

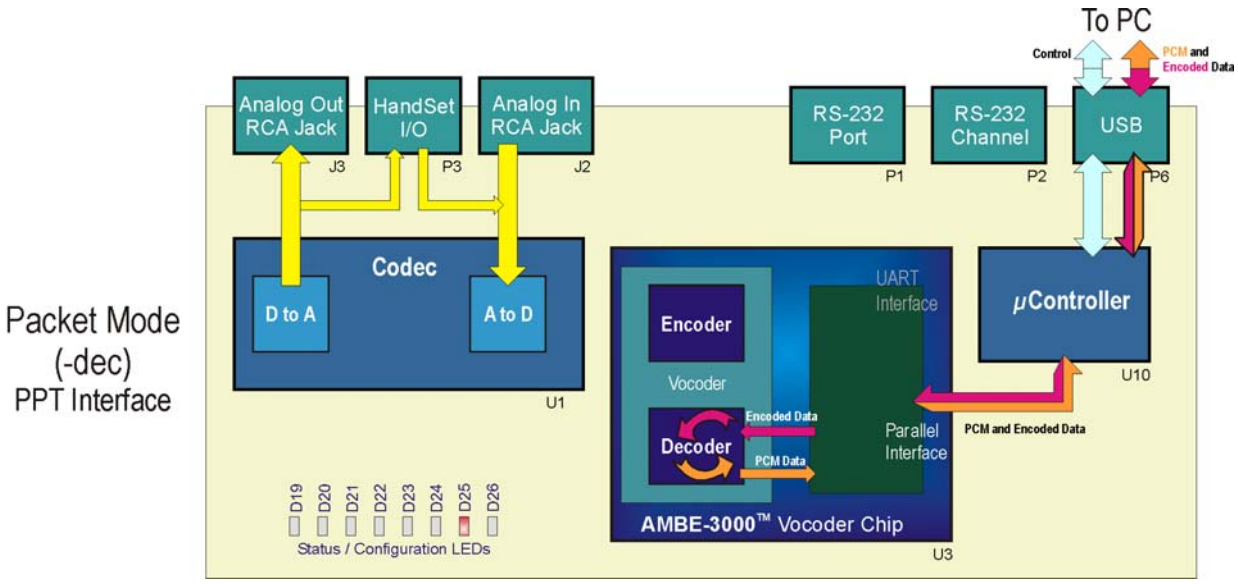


Figure 17 Packet Mode -dec PPT Interface Block Diagram

or

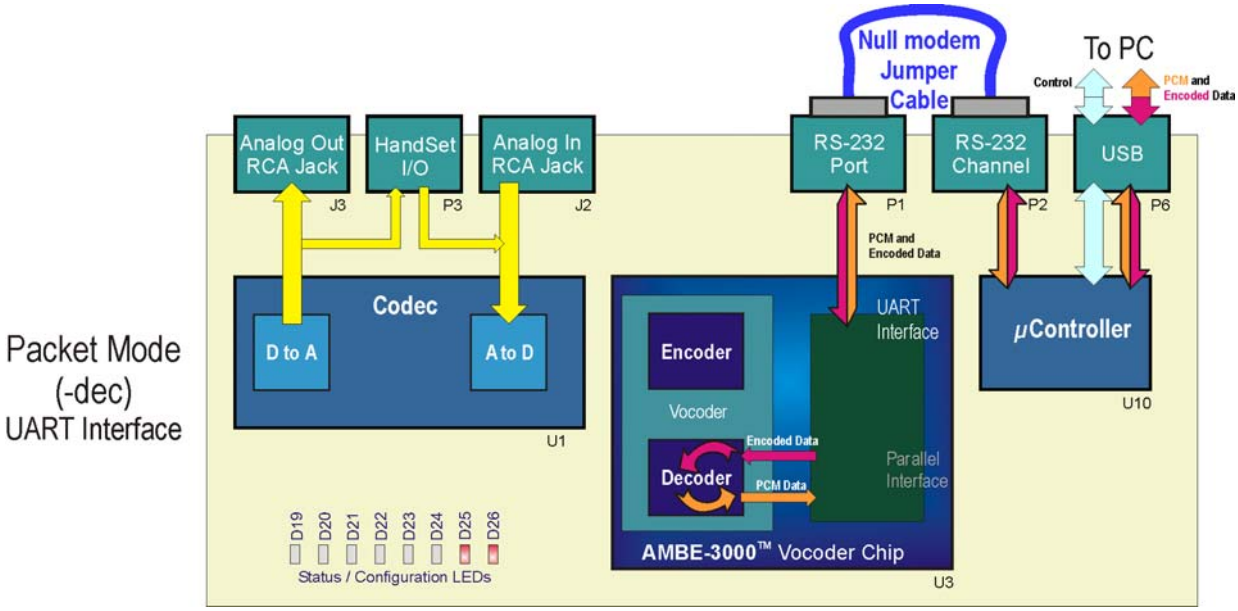


Figure 18 Packet Mode -dec UART Interface Block Diagram

Packet Mode Decode File Example:

```
C:\ Command Prompt
hdkcom.exe –port COM4 460800 –uart or –ppt –r 39 -dec dvsi36tst.bit
dvsi36tst.pcm
```

where

`COM4` is the COM port on the PC that the HDK will communicate on

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip **or** `-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip *If neither `–ppt` or `–uart` is specified the PPT interface is used by default.*

`-r 39` is the rate index of the bit rate the file is to be decoded at 3600bps.

`-dec` decodes the previously encoded file and saves it to a file

`dvsi36tst.bit` is the name of the encoded file to be decoded

`dvsi36tst.pcm` is the name of the file to be saved

To validate that the file was decoded correctly simply compare the created file `dvsi36tst.pcm` with the similar file `dvsi36.pcm` included on the HDK CD.
In the HDK directory use the following DOS command.

Packet Mode
(-encdec)
PPT Interface

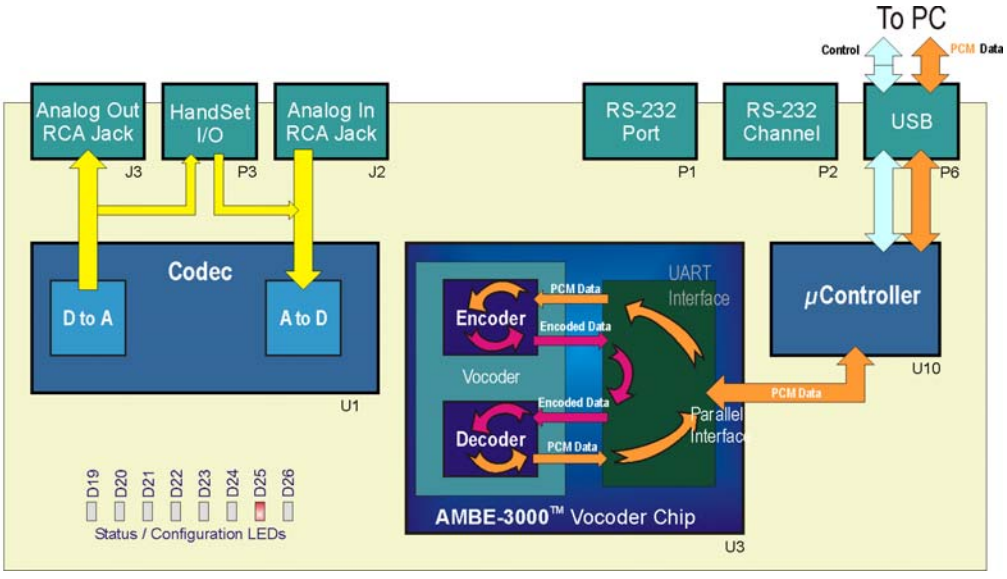


Figure 19 Packet Mode Encode/Decode PPT Interface Block Diagram

or

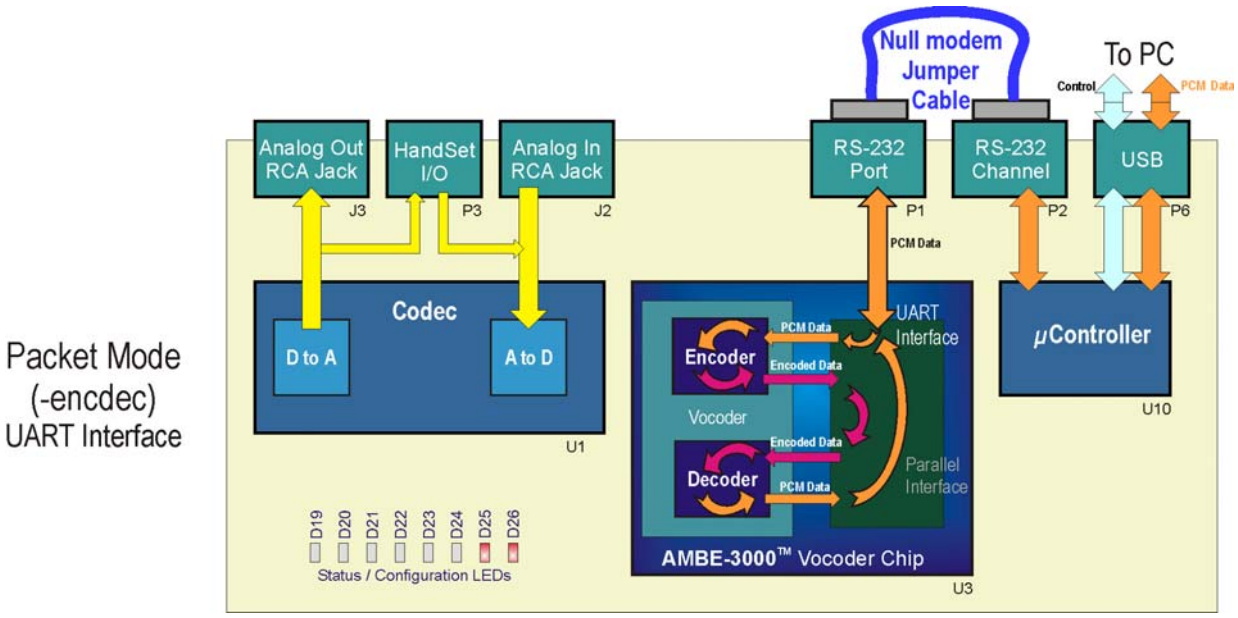


Figure 20 Packet Mode UART Interface Block Diagram

Packet Mode Encode/Decode File Command Example:

```
C:\ Command Prompt
hdkcom.exe –port COM4 460800 –uart or –ppt –r <rate index or rate words in
hex> -encdec <input filename> <output filename>
```

where

`COM4` is the COM port on the PC that the HDK will communicate on

`460800` is the baud rate of the PC connection

`-r` is the rate index of the bit rate the file is to be decoded at. See Table 23 Standard Rate Table for AMBE-3000™. To use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`–encdec` the HDK encodes the following input PCM file then decodes it and saves it to a PCM file with the following output file name

`<input filename>` is the name of the file to be encoded/decoded

`<output filename>` is the name of the file to be saved

LoopBack Mode

LoopBack Mode using the AMBE-3000™ Vocoder chip's Parallel Interface.
In Loopback the AMBE-3000™ Vocoder chip (Parallel Interface), analog speech from the handset or RCA jack input connections gets digitized by the codec, encoded by the AMBE-3000™ Vocoder chip and sent out its parallel interface to the micro controller. The encoded data is then returned back to the AMBE-3000™ vocoder chip, where it gets decoded, sent to the codec, and output the RCA jacks or handset depending on the user settings.

LoopBack
(Parallel Interface)

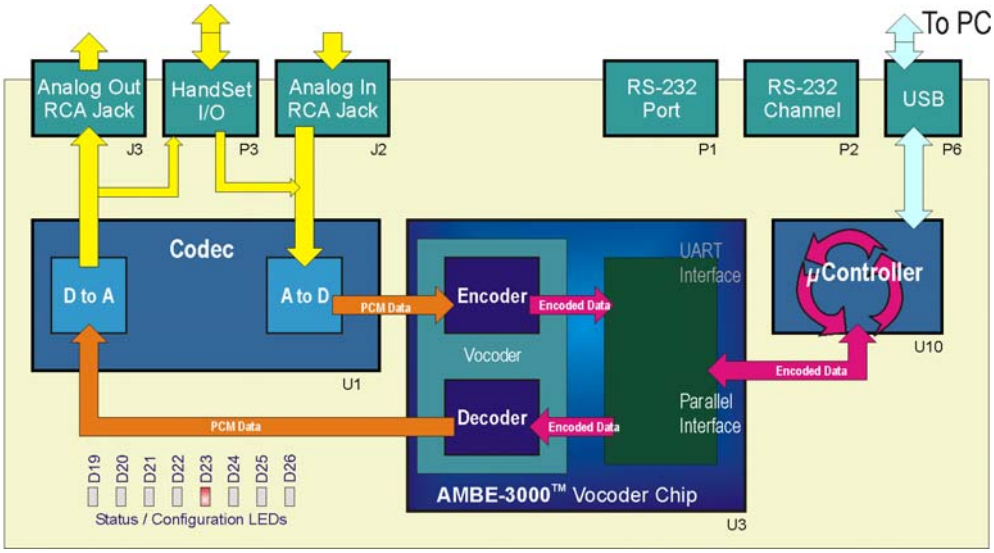


Figure 21 LoopBack PPT Mode AMBE-3000™ Vocoder Chip (Parallel Interface)

LoopBack Mode using the AMBE-3000™ Vocoder chip's UART Interface
In Loopback the AMBE-3000™ Vocoder chip UART Interface Analog speech input from the handset or RCA jack input connections gets digitized by the codec then encoded the AMBE-3000™ Vocoder chip. The encoded data is then sent out the chips UART interface to the P2 connector. This data is then loopbacked to the micro controller by physically connecting a null modem serial cable to the DB9 connectors P2 and P1. The microcontroller then sends the data to the AMBE-3000™ vocoder chip, where it gets decoded and sent to the codec to be output the RCA jacks or handset depending on the user settings.

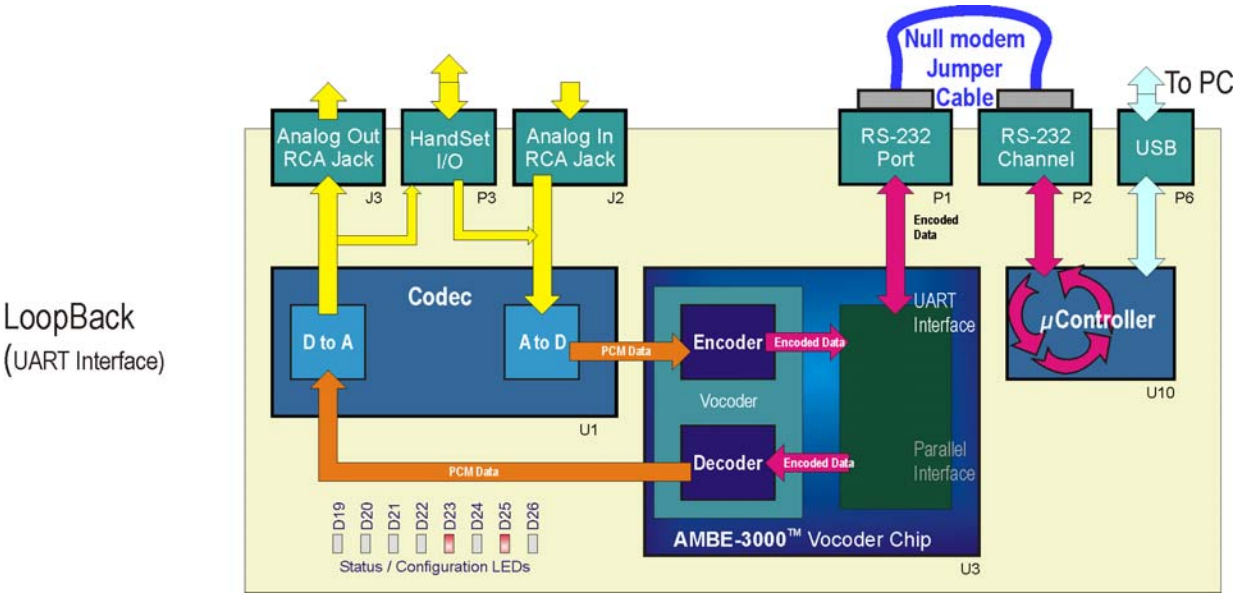
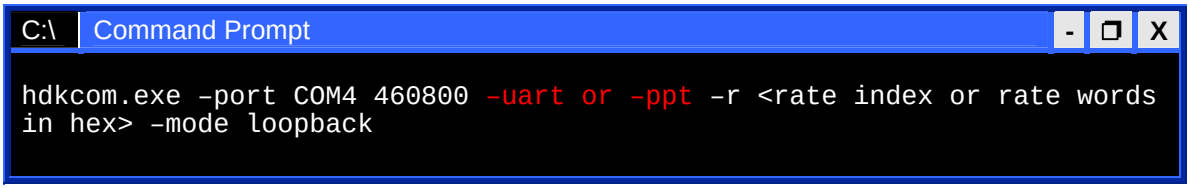


Figure 22 LoopBack UART Mode AMBE-3000™ Vocoder Chip (UART Interface)

LoopBack Mode Command Example



where:

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-ppt` sets the HDK to use the PPT Interface of the AMBE-3000™ Vocoder chip
or
`-uart` sets the HDK to use the UART Interface of the AMBE-3000™ Vocoder chip

If neither `–ppt` or `–uart` is specified the PPT interface is used by default.

`-r` is the rate index of the bit rate the file is to be decoded at. See Table 23 Standard Rate Table for AMBE-3000. To use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-mode loopback` is to set the board into Loopback Mode

Note: Once the HDK is set to Loopback Mode it will stay in this mode until another command is issued to put it into another mode. It is recommended to always switch back into Idle Mode before switching in between modes.

A3kdirect Mode

A3kdirect Mode is used so that the AMBE-3000 HDK can connect the AMBE-3000™ Vocoder Chip's UART Interface to a PC across the RS-232 channel interface (P1). This physical link establishes a communication connection where the PC can send any packets (speech, channel or control) directly to the vocoder chip's UART Interface and get either Compressed speech or PCM packets in return. Additionally, the HDK can be set to receive PCM packets to be encoded and decoded and the sent back as PCM data.

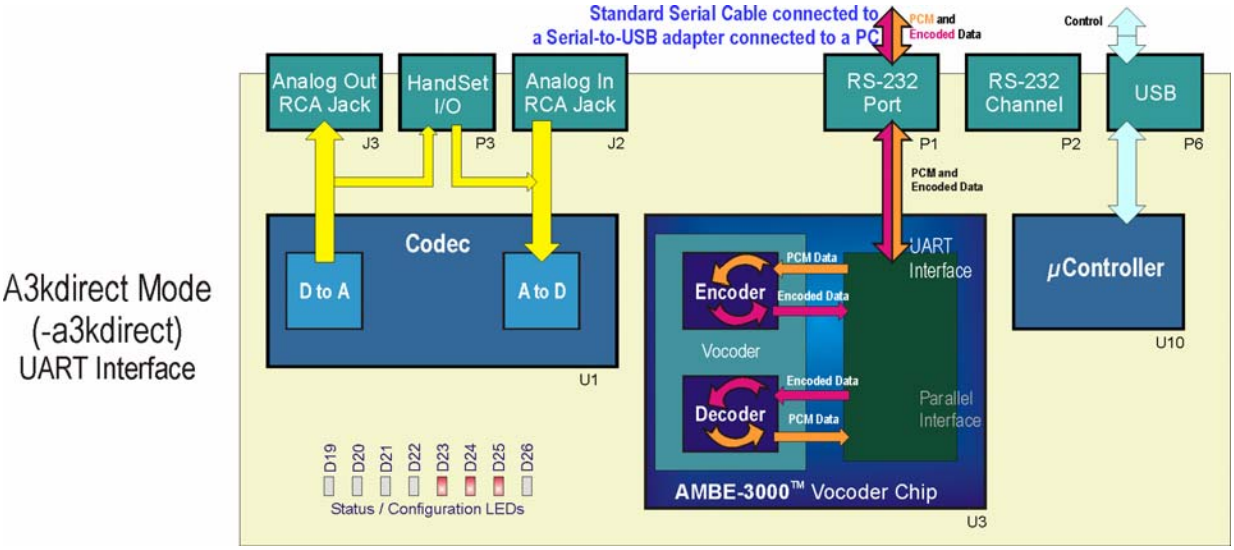
The data rate required for this interface may exceed the capability of some RS-232 hardware. DVSI has tested this connection using the High Speed Serial Adapter USA-19HS manufactured by Keyspan. The adapter will provide the user a high speed connection between the HDK's serial port P1 to a USB port on a USB equipped Windows PC.

To set the data rate use the switch settings for SW2 as shown in Table 22 AMBE-3000™ Vocoder Chip UART Baud Rate Selection.

Note: For all modes other than A3kdirect Mode the SW2 switch settings for Positions 5, 6 and 7 should be set for 460,800 baud.

Baud Rate (baud)	Position 7	Position 6	Position 5
28,800	ON	ON	ON
57,600	ON	ON	OFF
115,200	ON	OFF	ON
230,400	ON	OFF	OFF
460,800	OFF	ON	ON
921,600	OFF	ON	OFF

Table 22 AMBE-3000™ Vocoder Chip UART Baud Rate Selection



A3kdirect Command Example

```
C:\ Command Prompt
hdkcom.exe –port COM4 460800 –r <rate index or rate words in hex> –mode
a3kdirect
```

where:

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-r` is the rate index of the bit rate the file is to be decoded at. See Table 23 Standard Rate Table for AMBE-3000. To use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-mode dsp` is to set the board into A3kdirect Mode

Note: Once the HDK is set to A3kdirect Mode it will stay in this mode until another command is issued to put it into another mode. It is recommended to always switch back into Idle Mode before switching in between modes.

Dual HDK Mode (Full Duplex)

The AMBE-3000 HDK can be directly connected to a second AMBE-3000 HDK using the RS-232 channel interface (P2). This physical link establishes a real-time, full-duplex communication connection between the two units. Each board can select either the handset or line-in input as the audio source.

The analog voice from the first HDK Board is encoded and sent across the RS-232 interface to the second HDK Board where the incoming channel packets get decoded and played out on the audio output of the second HDK Board. At the same time the second AMBE-3000™-HDK Vocoder board can encode speech from its analog input and send the encoded packet across the RS-232 channel to be

decoded by first AMBE-3000™-HDK Development Board. The HDK Board implements an asynchronous RS-232 serial interface for channel data using a protocol designed by DVSI.

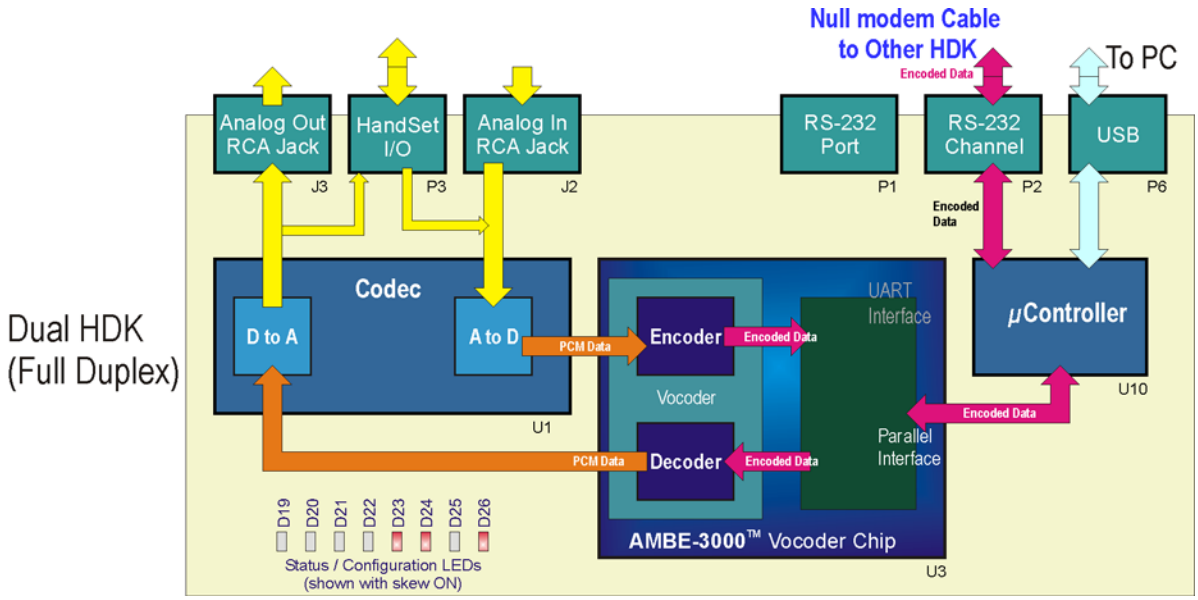
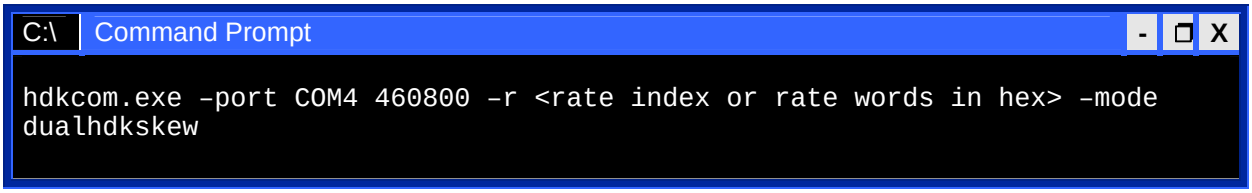


Figure 23 Full Duplex Mode

Full Duplex Communication Setup and Control

To set up a full duplex communication system between two HDK boards, each board must be individually configured and then the connection (P2 to P2) between the two boards can be made. In order for two boards (board "A" to connect to board "B") one board (board "A") has to be programmed with skew control ON and the other board (board "B") with skew control OFF. Both boards "A" and "B" must be set to the same vocoder rate.

To set up the first board "A" with skew ON run the following commands:



where:

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-r` is the rate index of the bit rate the file is to be decoded at. See Table 23 Standard Rate Table for AMBE-3000. To use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-mode dualhdkskew` is to set the board into Dual HDK Mode with skew ON

Note: Once the HDK is set to Dual HDK Mode it will stay in this mode until another command is issued to put it into another mode. It is recommended to always switch back into Idle Mode before switching in between modes.

To set up the second board "B" with skew OFF run the following commands:

where:

`-port COM4` is the PC's COM port that the HDK communicates on as indicated by Windows Device Manger

`460800` is the baud rate of the PC connection

`-r` is the rate index of the bit rate the file is to be decoded at. See Table 23 Standard Rate Table for AMBE-3000. To use rate words to set the rate – the format must be six words in hex separated by a space as shown in the following example:

```
-r 0x0460 0x0986 0x0000 0x0000 0x0000 0x5660
```

`-mode dualhdk` is to set the board into Dual HDK Mode

Note: Once the HDK is set to Dual HDK Mode it will stay in this mode until another command is issued to put it into another mode. It is recommended to always switch back into Idle Mode before switching in between modes.

Now connect the two boards "A" to "B" using a cable as shown in Figure 24 Two HDK boards connected together.

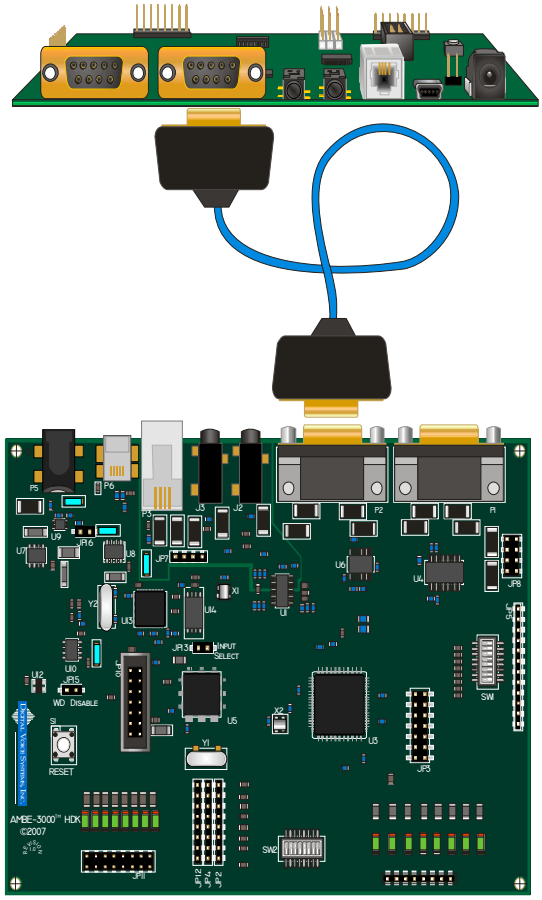


Figure 24 Two HDK boards connected together

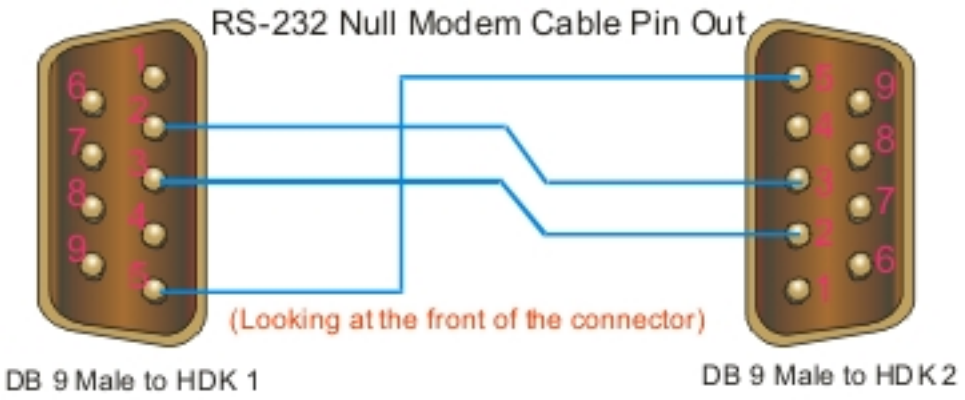


Figure 25 RS-232 Null Modem Cable Pin-out

This cable configuration is used for "Dual-HDK Mode", Codec Mode UART Interface, Packet Mode UART Interface and "UART Loopback Mode".

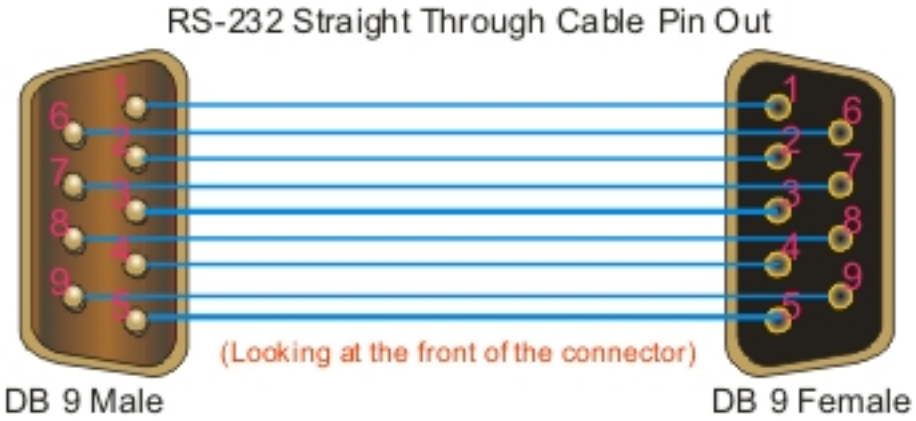


Figure 26 RS-232 Straight through Cable Pin-out

This cable is used for connecting the RS-232 interface to a PC or other serial device.

"HDK UART" Data Packet Structure

Data packets sent as byte-aligned frames over the asynchronous RS-232 UART Serial interface. This helps maintains compatibility with asynchronous 8N1 framing and synchronization if channel errors exist.
The packet is the same structure as described in the AMBE-3000™ Vocoder chip Users Manual.

Documentation & Software Development

Documentation

A full set of schematics is included with the AMBE-3000™ HDK.

The AMBE-3000™ Vocoder Chip User's Manual and a HDK Software Manual is included.

The User's manual describes the hardware and software features of the AMBE-3000™ HDK. The Software Manual provides a code description for the included HDK board source code.

Software

Software development for the MSP430F1471 can be done using the freely* available Code Composer Essentials from Texas Instruments. Code Composer Essentials was chosen for this design because it is an integrated development environment for the MSP430. Debug operations are more fluid than other solutions not supported by TI. The software is supported by TI which is an advantage because they manufacture the CPU.

*Code Composer Essentials Version 3 is free for images up to 16Kb. Larger images require a license. The code for the AMBE-3000™ HDK is under 8Kb.

In addition to Code Composer Essentials, we will be using the MSP-FET430UIF emulator tool for programming and debug operations. http://focus.ti.com/docs/toolsw/folders/print/msp-fet430uif.html

The AMBE-3000™ HDK is shipped with source code for the MSP430F1471 (also a compiled image), source code for the PC executable (and the executable itself). The source code will allow the designers to rapidly prototype their own AMBE-3000™ designs.

The TUSB3410 USB drivers are required and may be downloaded at ti.com.

Third Party Tools

MSP-430 Flash Programmer
Part Number: MSP-PRGS430
http://focus.ti.com/docs/toolsw/folders/print/msp-prgs430.html

MSPGCC MSP-430 GNU Compiler
http://mspgcc.sourceforge.net/

Specifications

Overview

This section contains hardware Specifications of the AMBE-3000™-HDK Development Board.

NOTE: All specifications subject to change.

Board Connections

Serial Port 1 Packet Interface Port (P1)	
Type	RS-232 asynchronous
Connector	

RS 232 Serial Port Pin Out	
Pin Number	Name
1	Connected to Pins 4 and 6
2	Tx Channel Out
3	Rx Channel In
4	Connected to Pins 1 and 6
5	Connected to Ground
6	Connected to Pins 1 and 4
7	Tx Channel Out
8	Rx Channel In
9	No Connection

Serial Port 2 Channel Data (P2)	
Type	RS-232 asynchronous
Connector	

RS 232 Serial Port Pin Out	
Pin Number	Name
1	Connected to Pins 4 and 6
2	Tx Channel Out
3	Rx Channel In
4	Connected to Pins 1 and 6
5	Connected to Ground
6	Connected to Pins 1 and 4
7	Tx Channel Out
8	Rx Channel In
9	No Connection

USB Serial Port (P6)	
Type	Serial
Connector	Mini USB B SMT

USB Pin Out	
Pin Number	Name
1	USB_5v
2	D-
3	D+
4	ID
5	Connected to Ground
6, 7, 8, 9	Shield

Audio I/O Connections

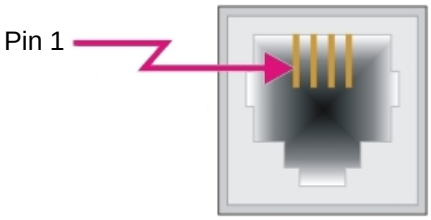
Line In (J2)	
Type	Single-ended Input
Connector	female 3.5mm Audio Jack
Maximum Input Level:	1.41 Volts RMS
Input Impedance	10 ohms nominal
Bandwidth	20 Hz to 4 kHz (up to 48 kHz. available)
D/A Resolution	16 bits
D/A Sampling Rate:	8 kHz (up to 96kHz. available)
SNR (Non-Weighted)	81 dB

Note: A 1.414 V signal on the line input produces digital max when the codec input gain is 0 dB.

Line Out (J3)	
Type:	Single-ended Output
Connector:	female 3.5mm Audio Jack
Maximum Output Level	1.0 Volt RMS
Output Impedance:	<50 Ohms
Bandwidth:	20 Hz to 3.6 kHz (up to 48 kHz. available)
A/D Resolution:	16 bits
SNR (Non-Weighted)	84 dB
A/D Sampling Rate:	8 kHz (up to 96kHz. available)
Minimum Load	10k Ohms nominal

Handset (P3)	
Type:	Single-ended
Connector:	RJ 4P4C
Bandwidth:	20 Hz to 4 kHz
A/D Sampling Rate:	8 kHz
A/D Resolution:	16 bits

Handset Pin Out (RJ11 Connector)	
Pin #	Signal Name
1	Connected to Ground
2	Analog Out P1
3	Speaker Out
4	Microphone In/DC Microphone Bias out



Handset Header (JP7)	
Pin Number	Name
1	Connected to Ground
2	Analog Out P1
3	Speaker Out
4	Microphone In/DC Microphone Bias out

Header Connections

DSP JTAG (J15)			
Pin Number	Name	Pin Number	Name
1	TMS	8	Digital Ground
2	TRSTn	9	TCK
3	TDI	10	Digital Ground
4	Digital Ground	11	TCK
5	Sys_3v3	12	Digital Ground
6		13	EMU0
7	TDO	14	EMU1

Electrical Input

Power (P5)	
Pin Number	Name
Center	+5 Volts DC
Shield	Ground

DC Power	
Input Voltage	5 Volts DC
Input Current	250 ma @ 5V DC

Mechanical

Mechanical	
Weight	5.3 oz.
Size (W X D)	6.75"X 5.5"

Appendix

Rate Tables

Total Rate (bps)	Speech Rate (bps)	FEC Rate (bps)	Rate Index	Switch 1 Settings Positions 1-6 0 is OFF, 1 is ON					
				3	4	5	6	7	8
2000	2000	0	31	1	0	0	0	0	0
2250	2250	0	36	0	1	1	0	1	1
2400	2400	0	0	1	1	1	1	1	1
	2350	50	5	1	1	1	0	1	0
	2400	0	37	0	1	1	0	1	0
2450	2450	0	34	0	1	1	1	0	1
2700	2450	250	47	0	1	0	0	0	0
3000	3000	0	38	0	1	1	0	0	1
3400	2250	1150	35	0	1	1	1	0	0
3600	3600	0	1	1	1	1	1	1	0
	3350	250	11	1	1	0	1	0	0
	3600	0	16	1	0	1	1	1	1
	2450	1150	33	0	1	1	1	1	0
	3600	0	39	0	1	1	0	0	0
	3350	250	48	0	0	1	1	1	1
4000	4000	0	15	1	1	0	0	0	0
	3750	250	14	1	1	0	0	0	1
	4000	0	17	1	0	1	1	1	0
	2400	1600	22	1	0	1	0	0	1
	4000	0	40	0	1	0	1	1	1
	3750	250	49	0	0	1	1	1	0
	2600	1400	55	0	0	1	0	0	0
4400	4400	0	41	0	1	0	1	1	0
	2450	1950	51	0	0	1	1	0	0
4800	4800	0	3	1	1	1	1	0	0
	4550	250	7	1	1	1	0	0	0
	3600	1200	2	1	1	1	1	0	1
	3100	1700	8	1	1	0	1	1	1
	4800	0	18	1	0	1	1	0	1
	4000	800	24	1	0	0	1	1	1
	3600	1200	23	1	0	1	0	0	0
	2400	2400	25	1	0	0	1	1	0

	4800	0	42	0	1	0	1	0	1
	4550	250	50	0	0	1	1	0	1
	2450	2350	52	0	0	1	0	1	1
	3600	1200	56	0	0	0	1	1	1
	4000	800	57	0	0	0	1	1	0
6000	2450	3550	53	0	0	1	0	1	0
6400	4150	2250	10	1	1	0	1	0	1
	6400	0	19	1	0	1	1	0	0
	4000	2400	26	1	0	0	1	0	1
	3600	2800	32	0	1	1	1	1	1
	6400	0	43	0	1	0	1	0	0
	4000	2400	58	0	0	0	1	0	1
7200	4400	2800	9	1	1	0	1	1	0
	4400	2800	27	1	0	0	1	0	0
	7200	0	44	0	1	0	0	1	1
	2450	4750	54	0	0	1	0	0	1
	4400	2800	59	0	0	0	1	0	0
8000	7750	250	12	1	1	0	0	1	1
	4650	3350	13	1	1	0	0	1	0
	8000	0	20	1	0	1	0	1	1
	4000	4000	28	1	0	0	0	1	1
	8000	0	45	0	1	0	0	1	0
	4000	4000	60	0	0	0	0	1	1
9600	9600	0	4	1	1	1	0	1	1
	4850	4750	6	1	1	1	0	0	1
	9600	0	21	1	0	1	0	1	0
	3600	6000	30	1	0	0	0	0	1
	2400	7200	29	1	0	0	0	1	0
	9600	0	46	0	1	0	0	0	1
	3600	6000	61	0	0	0	0	1	0

Table 23 Standard Rate Table for AMBE-3000™

Table 14 Key
AMBE-1000™ Rates (AMBE™ Vocoder)
AMBE-2000™ Rates (AMBE+™ Vocoder)
AMBE-3000™ Rates (AMBE+2™ Vocoder)

Vocoder Rates by Index Number				
AMBE-1000™ Rates				
Rate Index #	**Total Rate**		**Speech Rate**	**FEC Rate**
0	2400		2400	0
1	3600		3600	0
2	4800		3600	1200
3	4800		4800	0

4	9600		9600	0
5	2400		2350	50
6	9600		4850	4750
7	4800		4550	250
8	4800		3100	1700
9	7200		4400	2800
10	6400		4150	2250
11	3600		3350	250
12	8000		7750	250
13	8000		4650	3350
14	4000		3750	250
15	4000		4000	0

AMBE-2000™ Rates				
Rate Index #	**Total Rate**		**Speech Rate**	**FEC Rate**
16	3600		3600	0
17	4000		4000	0
18	4800		4800	0
19	6400		6400	0
20	8000		8000	0
21	9600		9600	0
22	4000		2400	1600
23	4800		3600	1200
24	4800		4000	800
25	4800		2400	2400
26	6400		4000	2400
27	7200		4400	2800
28	8000		4000	4000
29	9600		2400	7200
30	9600		3600	6000
31	2000		2000	0

AMBE-3000™ Rates				
Rate Index #	**Total Rate**		**Speech Rate**	**FEC Rate**
32	6400		3600	2800
33	3600		2450	1150
34	2450		2450	0
35	3400		2250	1150
36	2250		2250	0
37	2400		2400	0
38	3000		3000	0
39	3600		3600	0
40	4000		4000	0
41	4400		4400	0
42	4800		4800	0
43	6400		6400	0
44	7200		7200	0
45	8000		8000	0
46	9600		9600	0
47	2700		2450	250
48	3600		3350	250
49	4000		3750	250
50	4800		4550	250
51	4400		2450	1950

52	4800		2450	2350
53	6000		2450	3550
54	7200		2450	4750
55	4000		2600	1400
56	4800		3600	1200
57	4800		4000	800
58	6400		4000	2400
59	7200		4400	2800
60	8000		4000	4000
61	9600		3600	6000

File Formats

The HDKCOM.EXE program uses three types of files for storing input and/or output data transferred to/from the HDK-3000™. The 3 file formats are as follows:

1. PCM File. A PCM file is a binary file that contains 16-bit PCM speech samples sampled at 8 kHz. The file does not contain any header information. It contains only speech data. The data may be input to the encoder or or output from the decoder. Each speech sample occupies two successive bytes in the file. The first byte contains the least significant 8-bits of the PCM sample and the second byte contains the most significant 8-bits of the PCM sample. To illustrate this assume that the following 16-bit PCM samples are stored in a PCM file:

   ```
   0x0001, 0x0002, 0x0004, 0x0008, 0x0010, 0x0020, 0x0040, 0x0080,
   0x0100, 0x0200, 0x0400, 0x0800, 0x1000, 0x2000, 0x4000, 0x8000
   ```

   The order in which the bytes are read from the file is as follows:

   ```
   0x01, 0x00, 0x02, 0x00, 0x04, 0x00, 0x08, 0x00,
   0x10, 0x00, 0x20, 0x00, 0x40, 0x00, 0x80, 0x00,
   0x00, 0x01, 0x00, 0x02, 0x00, 0x04, 0x00, 0x08,
   0x00, 0x10, 0x00, 0x20, 0x00, 0x40, 0x00, 0x80.
   ```

2. Hard-Decision Bit File. A hard-decision bit file contains compressed speech data output by the encoder. The bit file can be used as input to the decoder. The data is packed using 8 bits per byte. For hard-decision, each bit must be 0 or 1. If the 16 bits

   ```
   a, b, c, d, e f, g, h, i, j, k, l, m, n, o, p
   ```

   are the first 16 bits stored in a hard-decision bit file. Then the first two bytes of the file will be binary `abcdefgh` and `ijklmnop` where a and `i` are the msb of each byte.

3. Soft-Decision Bit File. A soft-decision bit file contains compressed speech data output by the encoder that has then been converted to 4-bit soft-decision format. Soft-decsion format is not output directly by the encoder, but it can be input directly to the decoder when soft-decision decoding is specified. The data is packed using two soft-decision bits per byte. Each soft decision bit must be a 4-bit value in the range from 0x0 to 0xF. A binary "0" is represented as 0x0, 0x1, 0x2, 0x3, 0x4, 0x5, 0x6, or 0x7, with 0x0 being the most confident "0" and 0x7 being the least confident "0". A binary "1" is represented as 0xF, 0xE, 0xD, 0xC, 0xB, 0xA, 0x9, or 0x8, with 0xF being the most confident "1" and 0x8 being the least confident "1". If a soft-decision bit file is derived directly from a hard-decsion bit file, then each bit will have maximum confidence and will be equal to either 0x0 for "0" or 0xF for "1". If the 16 bits

   ```
   a, b, c, d, e f, g, h, i, j, k, l, m, n, o, p
   ```

   are the first 16 bits stored in a hard-decision bit file. Then the first eight bytes of the converted soft-decision format file will be binary

   ```
   aaaabbbb ccccdddd eeeeffff gggghhhh iiiijjjj kkkkllll mmmmnnnn oooopppp.
   ```

If each of the 16 4-bit soft-decsion bits are denoted as A, B, C, D, E, F, G, H, I, J, K, and L, then the first eight bytes of the the file could be expressed as hex AB, CD, EF, GH, IJ, KL, MN, and OP. A through P are each 4-bit soft-decsion bits in the range from 0x0 to 0xF. If the transmission is not ideal, then the values for each 4-bit soft-decsion bit will vary between 0x0 and 0xF depending upon the confidence of each received bit.

NOTE: Prior to HDK Release 005, the format for soft-decision bit files was different. The soft-decision bits were not packed. Each 4-bit soft-decision value was stored in one byte. This wasted space. Using the prior format, if the 16 bits

a, b, c, d, e f, g, h, i, j, k, l, m, n, o, p

are the first 16 bits stored in a hard-decision bit file. Then the first sixteen bytes of the converted soft-decsion file will be binary

0000aaaa 0000bbbb 0000cccc 0000dddd 0000eeee 0000ffff 0000gggg 0000hhhh
0000iiii 0000jjjj 0000kkkk 0000llll 0000mmmm 0000nnnn 0000oooo 0000pppp

or hex

0A, 0B, 0C, 0D, 0E, 0F, 0G, 0H, 0I, 0J, 0K, 0L, 0N, 0O, 0P.

MSP430 Input/Output Pin Description

MSP430 Input/Output Pin Description

Pin No.	I/O Port Bank	Port No.	In/ Out	Description
12	P1	0	I	CODEC_FS_MSPn
13		1	I	TXRDY
14		2	I	RXRDY
15		3	I	PPTACK
16		4	I	TXFRM
17		5	O	SER_RTS
18		6	I	SER_CTS
19		7	O	USB_SER_CTSn
20	P2	0	I	USB_SER_RTSn
21		1	O	JP12 pin 8
22		2	O	JP12 pin 7
23		3	O	JP12 pin 6
24		4	O	JP12 pin 5
25		5	O	JP12 pin 4
26		6	O	JP12 pin 3
27		7	O	JP12 pin 2
28	P3	0	O	JP12 pin 1
29		1	O	PPT_READ
30		2	O	PPTWRITE
31		3	I	USB_CLOCK_OUT
32		4	O	USB_TX
33		5	I	USB_RX
34		6	O	SER_TX_DATA
35		7	I	SER_RX_DATA

Pin No.	I/O Port Bank	Port No.	In/ Out	Description
36	P4	0	I/O	PPT_DATA0
37		1	I/O	PPT_DATA1
38		2	I/O	PPT_DATA2
39		3	I/O	PPT_DATA3
40		4	I/O	PPT_DATA4
41		5	I/O	PPT_DATA5
42		6	I/O	PPT_DATA6
43		7	I/O	PPT_DATA7
44	P5	0	O	USB_SDA
45		1	O	USB_SCL
46		2	I	NC
47		3	O	USB_CLOCK_OUT
48		4	I	CODEC_INPUT_SEL
49		5	O	RXRQST
50		6	O	MSP_RESET
51		7	O	WATCHDOG
59	P6	0	O	CONFIG8
60		1	O	CONFIG9
61		2	O	CONFIG10
2		3	O	CONFIG11
3		4	O	CONFIG12
4		5	O	CONFIG13
5		6	O	CONFIG14
6		7	O	CONFIG15

Software Development

Software development will be accomplished by using the freely available Texas Instruments Code Composer Essentials that can be downloaded from their web site TI.com. This will give the purchaser an opportunity to compile code for them and to make changes to the provided code to test other configurations. Code Composer Essentials was chosen because it can be obtained free of charge. There are also versions available for most modern programming environments.

Additional Reference Material

AMBE-3000™ vocoder chip Users Manual
http://www.dvsinc.com/literature.htm

Application Report – Understanding Data Converters:
http://www-s.ti.com/sc/psheets/slaa013/slaa013.pdf

Support

DVSI Contact Information

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Email: info@dvsinc.com
World Wide Web: http://www.dvsinc.com

Table of Revisions

History of Revisions			
Revision Number	Date of Revision	Description	Page
0.3	Oct. 22, 2008	Added descrition to SW2 Pin 1	14
0.4	Nov. 17, 2008	Corrected Switch Positions in Table 23 Standard Rate Table for AMBE-3000™	47
		Added Steps 3 and 4 to HDK Software installation description	20
0.5	May 26, 2009	Fixed typo of 5 rate words to 6 rate words	36, 38, 39, 41
0.6	October 2009	Fixed typo in Rate table. Deleted Rate Control Word Data	40, 50
0.7	October 2009	Added information about play_sd	25
0.8	April 2010	Edited switch On/Off positions in Table 23 Standard Rate Table for AMBE-3000™	50
0.9	December 2010	Fixed typo of RS-232 Null Modem Cable	8
1.0	April 2013	Edited TableTable 19 HDK Boot-up Mode Selection	19
1.1	July 2014	Edited web page link for the TI driver	5

NOTES